DOCUMENT RESUME

ED 261 912 SO 015 615

AUTHOR Melnick, Rob; Ronan, Bernard
TITLE Visions of the Future. Social Science Activities Text. Teacher's Edition.
INSTITUTION Hudson Inst., Indianapolis, IN.
PUB DATE 84
NOTE 98p.; For student activities text, see SO 015 616.
AVAILABLE FROM International Center for the Development of Thinking Skills, P.O. Box 705, Larchmont, NY 10538 ($14.95)
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Comparative Analysis; Decision Making; Environmental Education; *Futures (of Society); *Global Approach; Industrialization; Learning Activities; Natural Resources; Population Education; Problem Solving; Secondary Education; *Social Change; *Social Sciences; *Social Studies; Technological Advancement; Technology; United States History; Units of Study; *World Problems
IDENTIFIERS Interdependence

ABSTRACT

Intended to put both national and global issues into perspective and help students make decisions about their futures, this teacher's edition provides instructional objectives, ideas for discussion and inquiries, test blanks for each section, and answer keys for the 22 activities provided in the accompanying student text. Designed to provide high school students with various approaches for thinking about future resources, the program can be integrated into high school social science classes. Activities in the first section, "How to Think about the Future," focus on levels of certainty about the future, people who predict the future, a "doctor" who predicted the future, what may happen in the next hundred years, and predicting personal futures. In the activities in the second section, "The Great Transition," students use graphs and tables to make comparisons of the United States before and after industrialization; do library research on seven periods of U.S. history; learn to read charts showing social change, exponentiality, and trends and countervailing forces; read articles on world economic interdependence; and examine a chart showing change agents and technology. In the next section, students read scenarios and solve resource problems, then discuss articles on resource costs and supplies, technological applications to resource and energy issues, future energy issues, technology and the activities. (LH) end of each unit. (LH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED261912

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

Minor changes have been made to improve reproduction quality.

Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Sinclair L. Melner

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Visions of the Future

Social Science Activities Text Teacher's Edition

Developed by Hudson Institute

SO 015 615

VISIONS OF THE FUTURE

A Textbook on the Past, Present and Future

Teacher's Edition

By
Rob Melnick and Bernard Ronan
Hudson Institute

Published through the joint efforts of the Hudson Institute/Indiana and the International Center for the Development of Thinking Skills/New York

Copyright 1984
Hudson Institute
All Rights Reserved

Printed in the U.S.A.

Published by Hudson Institute/Indiana
Published and Distributed by:
International Center for the Development
of Thinking Skills
5 Canal Road
Pelham Manor, NY 10803

No part of this publication may be reproduced in
whole or in part, or stored in a retrieval system,
or transmitted in any form or by any means, electronic,
mechanical, photocopying, recording, or otherwise,
without written permission of the publishers.

VISIONS OF THE FUTURE

TEACHER'S EDITION
INTRODUCTION

The VISIONS OF THE FUTURE Teacher's Edition contains sample answers (and suggestions for related discussion) for the activities in the VISIONS OF THE FUTURE Student Text. The activities were designed to be open-ended and challenging. Some activities require students to merely fill-in simple answers; other activities will require them to conduct research outside the classroom, and will prompt them to engage in thought-provoking discussion in the classroom. For this reason, many of these latter activities have no "right" answers. Instead, we suggest a range of appropriate answers.

Students will frequently be asked to "make-up their own mind" on issues, to discern their own values, and to "take a stand." This is consistent with one of the goals of the VISIONS OF THE FUTURE Project: to serve as a "lobby for the future," pointing out problems and prospects, and engaging teachers and students in active debate and discussion about our common future.

The test items contained at the end of each unit cover VOF content for that unit. These items are <u>not</u> intended for use <u>in toto</u> as a test; there are intentional redundancies in order to offer choices to the instructor. Given this "bank" of test items, and by selecting items appropriate to class coverage of the material, the instructor can create a VOF cognitive test. The activities included in the VOF Student Text are appropriate for testing students in a more in-depth manner (i.e., through the use of essay questions and research).

We hope that this edition will aid you in using the VOF materials.

This Teacher's Edition is designed to accompany the VISION OF THE FUTURE Student Text.

ACTIVITIES: HOW TO THINK ABOUT THE FUTURE

ACTIVITY 1

LEVELS OF CERTAINTY ABOUT THE FUTURE

What will the future be like in your lifetime? In your children's lifetime? In your children's children's lifetime? Dramatic changes are possible, and some can be predicted with a degree of certainty. That is, some changes are probable.

Look at the list below. Decide if each event is *possible*. Is it also *probable?* Place a check (√) in the "possible" column if you believe an event *could* happen and a "√" in the "probable" column if you believe the event is likely to happen. Then, decide whether each event is "desirable" or "undesirable."

FUTURE EVENTS	WILL IT OCCUR?		WHAT DO YOU THINK?		WHAT INFORMATION DID YOU BASE YOUR DECISION ON? WHERE CAN YOU GET MORE INFORMATION?
	POSSIBLE	PROBABLE	DESIRABLE	UNDESIRABLE	
1. Underwater cities	X		X		*See next page*
2. More Free Time	X	X	X		"
3. Increased crime	X	X		X	"
4. Computer-Managed Households	X	X	X		"
5. Major Changes in The Weather	X	X	X		"
6. New Sources of Energy	X	X	X		"
7. Car That Gets 100 Miles Per Gallon	X	X	X		"
8. Cure for Cancer	X		X		"
9. Greater Life Expectancy	X	X	X		"
10. End to Poverty	X		X		"
11. Mining on the Moon	X	X	X	X	"
12. Rising Unemployment	X			X	"
13. New Types of Food	X	X	X		"
14. Increasing Population	X	X	X	X	"
15. 3-Dimensional Television	X	X	X		"

ACTIVITY 1 — LEVELS OF CERTAINTY ABOUT THE FUTURE

What information did you base your decision on?
Where can you get more information?

1. a) *from reading about the legend of Atlantis*
   b) *library research on oceanography*
   c) *talk to an oceanographer*

2. a) *recent trends*
   b) *my parents' life*
   c) *library research*

3. a) *recent trends: more wealth, more crime*
   b) *FBI's Uniform Crime Report*
   c) *talk to the police department*

4. a) *trends show it's already happening*
   b) *computer magazines*

5. a) *technological advances mean we can change weather now; more pollution causes change, too*
   b) *library research; talk to a meteorologist*

6. a) *technology of solar, wind, geothermal, etc. sources*
   b) *books on energy*

7. a) *prototypes already exist*
   b) *car and science magazines*

8. a) *much research now underway; many forms have been cured*
   b) *talk to American Cancer Society; local hospital*

9. a) *trends for 200 years show growing life expectancy*
   b) *Encyclopedia*

10. a) *recent trends show people have more money*
    b) *Government reports, U.N. reports*

11. a) *technology is being developed by NASA*
    b) *books on space developement*

12. a) *trends fluctuate*
    b) *state and federal government reports*

13. a) *currently being developed*
    b) *science magazines*

14. a) *for 200 years population has increased*
    b) *government reports, U.N. reports*

15. a) *recent trends in technology*
    b) *science magazines; T.V. Guide*

ACTIVITY 1 — LEVELS OF CERTAINTY ABOUT THE FUTURE

NOTES: *Answers will vary, especially with regard to whether these future developments would be desirable or undesirable. This should provide much opportunity for class discussion. For example, students may disagree about whether changes in weather would be good or bad. Focus should be on global perspectives when discussing these issues.*

Most of these developments are already underway. Thus, their probability is likely. Challenge students to research these events on their own. (Note: most answers for "Where can you get more information?" will lead them towards independent library research.)

Several of these "Future Events" will be discussed in greater detail later in the text.

ACTIVITY 2

PEOPLE WHO PREDICT THE FUTURE

A. Following this introduction are three short articles. The first article describes a mystic who predicted the future during the sixteenth century and the second article was written by someone who predicted the future during the end of the nineteenth century. The final article offers predictions made very recently by well known authors and scientists. Read the articles and then answer the questions that follow:

(1) Do you believe that people can make reasonably accurate predictions by using "mystical" means such as staring into water, reading tarot cards, or studying astrology?

(2) Are scientists the best predictors? How can a journalist qualify as a predictor of the future? What methods or sources of information might a journalist or author use in order to make predictions?

B. On the lefthand half of a piece of paper, make a list of the predictions that are made by Asimov, Kahn and Cetron in the last article.

On the righthand half of the page, describe a reason given for each prediction. An example is provided below.

Example: **Prediction**	**Reason**
1. 50 years from now there will be more farms, parkland and wilderness. (Asimov)	1. Because industry will be moved into outer space.
2.	2.
3.	3.
4.	4.
5. The economic future of the U.S. looks good. (Kahn)	5. Cost cutting and better use of labor and equipment.
6.	6.
7.	7.
8.	8.
9.	9.
10. The gap between the rich and the poor will shrink. (Cetron)	10. Governments will use taxes to "even things out."
11.	11.
12.	12.
13.	13.
14.	14.
15.	15.

SEE NEXT PAGES

A.

(1) No.
Emphasis should be on the "magical" nature of these so-called techniques. Using a tarot card deck would illustrate this point. Suggest that they read the horoscope in the daily paper before the next class. Emphasize that these age-old techniques have been used by people to gain some control over the uncertainties of the future, but they are not based on objective evidence.

(2) Answers will vary.
Scientific evidence is surely the most solid basis for accurate predictions. However, scientists often focus on a narrow field or issue. Furthermore, even if scientists are the best predictors, their "rate" of correct predictions can be low. Emphasize the "levels of certainty" concept and that even with the facts, predicting is not an exact science.

Journalists have been somewhat successful as popularizers of future studies. Alvin Toffler (Future Shock) and John Naisbitt (Megatrends) are both journalists. The journalists perspective is important: one cannot predict the future without adequately understanding what is occurring in the present. Journalists also have much data available to them, and this aids in predicting.

Journalists often consult government reports, thereby using the data gathered by experts as a basis for their reports. Another method, called the "Delphi Technique", is widely used by futurists. It involves interviewing many recognized experts in a field and finding those things which they all agree on. Journalists rarely use computer projections or other "modeling" techniques like scientists do. Objective data and well-informed opinions are the best sources for future predictions.

B. On the lefthand half of a piece of paper, make a list of the the predictions that are made by Asimov, Kahn and Cetron in the last article.

On the righthand half of the page, describe a reason given for each prediction.

1. Fifty years from now there will be more farms, parkland and wilderness (Asimov).	*1. Industry will be moved into outer space.*
2. Factories for making chemicals and drugs will exist in space (Asimov).	*2. Vacuums exist in space because of being gravity-free. Solar radiation is abundant. Welding is better.*
3. Space will be used for waste disposal (Asimov).	*3. Waste is diluted by the void, and solar wind disperses it.*
4. Space factories will be mostly automated (Asimov).	*4. Robots will be used.*
5. Large space stations will house people for long periods. They will be used as bases for exploring (Asimov).	*5. People won't commute, so large stations will be needed.*
6. Present enemies (U.S. and U.S.S.R.) will cooperate in the future (Asimov).	*6. It is too inefficient to compete.*
7. The economic future of the U.S. looks good (Kahn).	*7. Cost-cutting measures and more efficient use of labor.*
8. U.S. GNP will grow by 3% per year for the next 20 years (Kahn).	*8. More productivity and less government regulation.*
9. There will be enormous improvements in the labor force (Kahn).	*9. Workers will be older, more experienced, and more productive.*
10. Service industries will grow (Kahn).	*10. Advances in computers, automation, and related technologies.*
11. Breakthroughs in technology will occur-new materials and new methods (Kahn).	*11-15. Advances in technology.*
12. Food and agriculture will improve (Kahn).	
13. Space technology will boom (Kahn).	
14. Medicine and health services will improve (Kahn).	
15. We will have a pollution-free car with a choice of 10 different fuels (Kahn).	

12

16. *Per capita income in the U.S. will double in 20 years (Kahn).*

17. *By 2050 A.D., the U.S. will have 4% of world population and 10% of world GNP (Kahn).*

18. *U.S. and Japan will be the wealthiest countries 50 years from now, followed by U.S.S.R. or China, France or West Germany (Kahn).*

16-18. *Advances in technology will spread worldwide, causing more world economic growth and development. (Reason must be inferred.)*

19. *U.S. may become complacent (Kahn).*

19. *Increased wealth often causes complacency.*

20. *Gap between rich and poor will shrink, as in Sweden (Cetron).*

20. *Government closes the gap through taxes and welfare.*

21. *Fathers will take paternity leave with mothers (Cetron).*

22. *Children will choose which parent to live with after a divorce (Cetron).*

23. *More people will live together before marriage (Cetron).*

24. *Women will have children while unmarried (Cetron).*

21-24. *Changes in societal values. (Reason must be inferred.)*

25. *More divorces will occur (Cetron)*

26. *ERA will be passed (Cetron).*

25. *Longer life spans.*

26. *Elderly opponents to ERA will have died.*

27. *More college programs for bright students (Cetron).*

28. *No college for average students (Cetron).*

29. *Two year community colleges will increase (Cetron).*

27-29. *Education will become more expensive, and therefore more diversity in course offerings will occur. (Reason must be inferred.)*

30. *People will work longer (Cetron).*

31. *People will shift jobs and share jobs more often (Cetron).*

32. *People will change careers (Cetron).*

30. *Longer life span. (Reason must be inferred.)*

31. *More team approaches to job tasks and interdependence. (Reason must be inferred.)*

32. *Both husband and wife will work.*

33. *Average work week will be 20 hours (Cetron).*

34. *Leisure activities will be a large industry*

35. *Creative people and professional athletes will earn the most money (Cetron).*

36. *People will not let any one group dictate rules (Cetron).*

37. *More ecumenism in religion (Cetron).*

38. *Medical ethics will be controversial (Cetron).*

33. *Advances in computers and robots.*

34. *Less time spent "at work."*

35. *Creativity will be rewarded and highly valued.*

36. *Growing diversity in values and lifestyles. (Reason must be inferred)*

37. *More intermarriage among people of different faiths.*

38. *Crucial "life and death" decisions will be common.*

NOTE: Some students will "cluster" answers according to logical groupings, e.g., grouping all of Asimov's predictions on space, or Kahn's predictions on new technologies.

As they move to listing the reasons for these predictions, there will be some predictions for which no reasons are given. Students should be challenged to suggest reasons themselves, thereby learning to reason deductively. Some reasons will serve as a basis for a number of seperate predictions, e.g., space development serves as a basis for several of Asimov's predictions. Students should be encouraged to see how developments "spinoff" from other advances. Finally, some predictions will be too complex for giving simple reasons, e.g., Kahn's predictions about world economic growth.

Some terms will have to be explained, e.g., biotechnology: ecumenism.

A "Doctor" Who Predicted the Future

Who would expect a doctor to record his prophecies in verse? In the mid-sixteenth century, a man by the name of Nostradamus did just that.

Doctor to France's royal Charles IX, Nostradamus wrote over a thousand poetic verses. In them he enclosed cataclysmic prophecies of events destined to take place hundreds of years in the future. No one is certain how Nostradamus arrived at his predictions, but it is claimed that he saw future events while staring into a water-filled brass bowl.

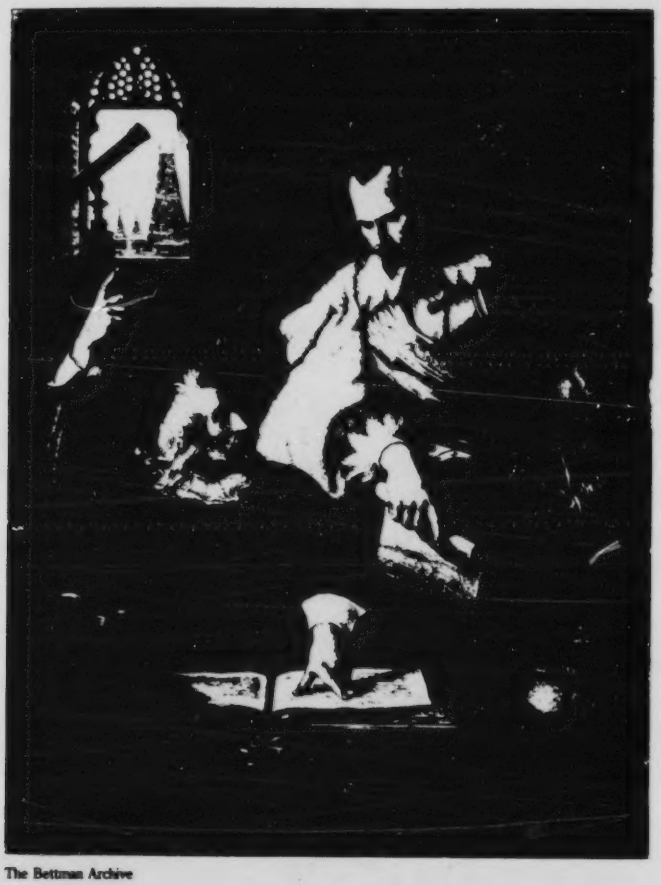
Some biographers interpret Nostradamus' words to predict many contemporary events such as the deaths of the Kennedy brothers — President John and Senator Robert — in the 1960s. They believe he also foretold the assassination attempt on Pope John Paul II, and predicts a future nuclear battle that will follow another major war. Nostradamus' critics, on the other hand, say that his verses are vague and provide little sense of time.

Here is one sample of his writing (translated) regarding the Pope.

> "Roman Pope do not approach the city which two rivers bathe. Your blood and that of your followers will flow near this place when the rose will flower." . . .

Another example of his verse may be a prediction about Napoleon, who was born to poor parents in Corsica, an island in the Mediterranean:

> "In the southern extremity of Western Europe a child shall be born of poor parents who by his tongue shall seduce the great army. His bruit shall extend to the kingdom of the East."



The Bettman Archive

Harold G. Shane & Gary A. Sojka

JOHN ELFRETH WATKINS, JR.

Forgotten Genius of Forecasting

Since the study of the future began to come of age a few decades ago, there has been considerable evidence to suggest that, as Niels Bohr humorously phrased it, "Prediction is very difficult, especially about the future."

Roy Amara, president of the Institute for the Future, is more precise: "Anything that you forecast is by definition uncertain," he tells us.

In view of the ease with which experts can err, the foresight and forecasts of a forgotten genius, John Elfreth Watkins, Jr., are phenomenal. His projection of developments in science and technology, reprinted here, was first published in *Ladies' Home Journal* in December 1900. The intervening years have provided ample time to verify his prescience, and his record is most impressive.

Watkins used an interview procedure to gather learned opinion for his forecasts—a procedure that in a limited sense anticipated the Delphi technique in that it was a judgment or consensus forecast.

Watkins, son of a curator of technological collections at the U.S. National Museum (now the Smithsonian Institution), was a journalist by profession and about 30 years old when this article was published. He rose to become managing editor of the Philadelphia Ledger Syndicate, which was part of the *Public Ledger*, a highly respected newspaper in its day. Furthermore, he was fortunate to live long enough to see many of his predictions come to fruition prior to his death during World War II.

To appreciate Watkins's forecasts fully, the reader must keep in mind the muscle-power era during which he wrote—an era in which the first automobiles had just appeared on U.S. roads west of the Mississippi River! It was a time in which women and children had virtually no rights, labor was exploited on the farm and in the factory and sweatshop, air travel was a remote dream, lifespans were brief, and the telephone

(Continued on page 10)

John Elfreth Watkins, Jr.

From *The Ladies' Home Journal*, December 1900

WHAT MAY THE NEXT

An all-but-forgotten journalist wrote some surprisingly accurate forecasts at the turn of the century.

These prophecies will seem strange, almost impossible. Yet they have come from the most learned and conservative minds in America. To the wisest and most careful men in our greatest institutions of science and learning I have gone, asking each in his turn to forecast for me what, in his opinion, will have been wrought in his own field of investigation before the dawn of 2001 — a century from now. These opinions I have carefully transcribed.

Five Hundred Million People. There will probably be from 350,000,000 to 500,000,000 people in America and its possessions by the lapse of another century. Nicaragua will ask for admission to our Union after the completion of the great canal. Mexico will be next. Europe, seeking more territory to the south of us, will cause many of the South and Central American republics to be voted into the Union by their own people.

The American Will Be Taller by from one to two inches. His increase of stature will result from better health, due to vast reforms in medicine, sanitation, food and athletics. He will live fifty years instead of thirty-five as at present—for he will reside in the suburbs. The city house will practically be no more. Building in blocks will be illegal. The trip from suburban home to office will require a few minutes only. A penny will pay the fare.

There Will Be No C, X or Q in our every-day alphabet. They will be abandoned because unnecessary. Spelling by sound will have been adopted, first by the newspapers. English will be a language of condensed words expressing condensed ideas, and will be more extensively spoken than any other. Russian will rank second.

"Hot or cold air will be turned on from spigots to regulate the temperature of a house. Rising early to build the furnace fire will be a task of the olden times."

Hot and Cold Air from Spigots. Hot or cold air will be turned on from spigots to regulate the temperature of a house as we now turn on hot or cold water from spigots to regulate the temperature of the bath. Central plants will supply this cool air and heat to city houses in the same way as now our gas or electricity is furnished. Rising early to build the furnace fire will be a task of the olden times. Homes will have no chimneys, because no smoke will be created within their walls.

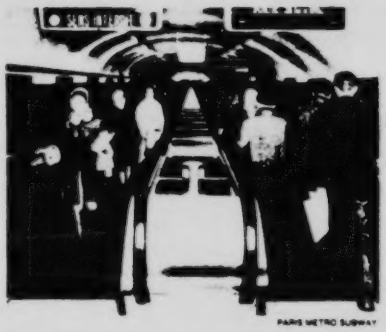
No Mosquitoes nor Flies. Insect screens will be unnecessary. Mos-

HAPPEN IN HUNDRED YEARS

quitoes, house-flies and roaches will have been practically exterminated. Boards of health will have destroyed all mosquito haunts and breeding-grounds, drained all stagnant pools, filled in all swamp-lands, and chemically treated all still-water streams. The extermination of the horse and its stable will reduce the house-fly.

Ready-Cooked Meals Will Be Bought from establishments similar to our bakeries of to-day. They will purchase materials in tremendous wholesale quantities and sell the cooked foods at a price much lower than the cost of individual cooking. Food will be served hot or cold to private houses in pneumatic tubes or automobile wagons. The meal being over, the dishes used will be packed and returned to the cooking establishments where they will be washed. Such wholesale cookery will be done in electric laboratories rather than in kitchens. These laboratories will be equipped with electric stoves, and all sorts of electric devices, such as coffee-grinders, egg-beaters, stirrers, shakers, parers, meat-choppers, meat-saws, potato-mashers, lemon-squeezers, dish-

"No foods will be exposed . . . . Refrigerators will keep great quantities of food fresh for long intervals."



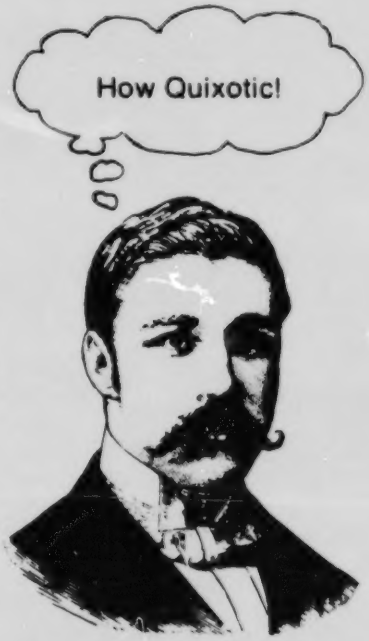
"In most cities hurry traffic will be confined to broad subways or tunnels . . . with 'moving-sidewalk' stairways leading to the top."

washers, dish-dryers and the like. All such utensils will be washed in chemicals fatal to disease microbes. Having one's own cook and purchasing one's own food will be an extravagance.

No Foods Will Be Exposed. Storekeepers who expose food to air breathed out by patrons or to the atmosphere of the busy streets will be arrested with those who sell stale or adulterated produce. Liquid-air refrigerators will keep great quantities of food fresh for long intervals.

Coal Will Not Be Used for Heating or Cooking. It will be scarce, but not entirely exhausted. The earth's hard coal will last until the year 2050 or 2100; its soft-coal mines until 2200 or 2300. Meanwhile both kinds of coal will have become more and more expensive. Man will have found electricity manufactured by water-power to be much cheaper. Every river or creek with any suitable fall will be equipped with water-motors, turning dynamos, making electricity. Along the seacoast will be numerous reservoirs continually filled by waves and tides washing in. Out of these the water will be constantly falling over revolving wheels. All of our restless waters, fresh and salt, will thus be harnessed to do the work which Niagara is doing to-day: making electricity for heat, light and fuel.

There Will Be No Street Cars in Our Large Cities. All hurry traffic will be below or high above ground when brought within city limits. In most cities it will be confined to broad subways or tunnels, well lighted and well ventilated, or to high trestles with "moving-sidewalk" stairways leading to the top. These underground or overhead streets will teem with capacious automobile passenger coaches and freight wagons, with cushioned wheels. Subways or trestles will be reserved for express trains. Cities, therefore, will be free from all noises.



"There will be no C, X, or Q in our everyday alphabet."

and telegraph were deemed to be miracles of modern science.

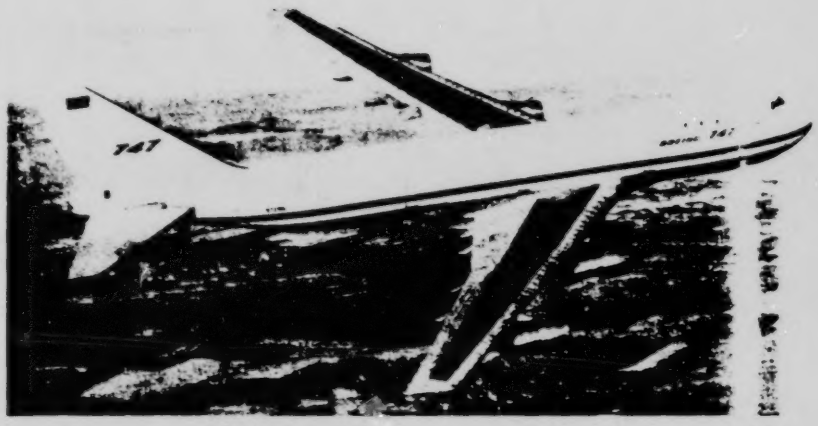
In view of the changes he was predicting, the number of forecasting "hits" scored by Watkins is astonishing: electric appliances would take over the kitchen; Americans would be taller, live longer, and be more concerned with health and fitness; high-speed trains would travel at 150 miles per hour; and automobiles would replace horses in all their work. Watkins also anticipated the use of planes, tanks, and submarines in warfare and correctly speculated that streetcars would be replaced by elevated trains and subways; that telephones would span the globe; and that cameras would transmit images around the world.

He also foresaw many social changes with remarkable clarity. These included a subsidized university education for every man and woman, and medical aid (along with free lunches) in schools for children of the poor.

In some of the predictions where Watkins went wrong, his mistake was not in the area of technology, but in not foreseeing the unpredictable qualities of humans. For example, Watkins concluded that strawberries might well become as large as apples and that peas would be as big as beets by the twentieth century's end. These prognostications were generally correct with respect to the capacity of modern plant science. However, Watkins did not make enough allowance for consumers' tastes and preferences changing with the passing years. While seed companies periodically have introduced "monster" varieties of, say, tomatoes, they generally have been less popular than those of "normal" appearance and texture—and ultimately tend to disappear from the market.

It would be an interesting venture, some 80 years from now, to review the work of contemporary writers in journals such as THE FUTURIST, in order to see whether their prognostications hold up as well as those of John Elfreth Watkins, Jr.! We doubt that many persons prospecting the future will be as successful as he was. We say this not to belittle contemporary futurists but because Watkins lived at the end of an era of relatively slow technological change. In his day, humans lived and died in more or less the same world into which they had

(Continued on page 12)



"There will be air-ships, but they will not successfully compete with surface cars and water vessels for passenger or freight traffic."

Photographs Will Be Telegraphed from any distance. If there be a battle in China a hundred years hence snapshots of its most striking events will be published in the newspapers an hour later. Even to-day photographs are being telegraphed over short distances. Photographs will reproduce all of Nature's colors.

Trains One Hundred and Fifty Miles an Hour. Trains will run two miles a minute, normally; express trains one hundred and fifty miles an hour. To go from New York to San Francisco will take a day and a night by fast express. There will be cigar-shaped electric locomotives hauling long trains of cars. Cars will, like houses, be artificially cooled. Along the railroads there will be no smoke, no cinders, because coal will neither be carried nor burned. There will be no stops for water. Passengers will travel through hot or dusty country regions with windows down.

Automobiles Will Be Cheaper Than Horses are to-day. Farmers will own automobile hay-wagons, automobile truck-wagons, plows, harrows and hay-rakes. A one-pound motor in one of these vehicles will do the work of a pair of horses or more. Children will ride in automobile sleighs in winter. Automobiles will have been substituted for every horse vehicle now known. There will be, as already exist to-day, automobile hearses, automobile police patrols, automobile ambulances, automobile street sweepers. The horse in harness will be as scarce, if, indeed, not even scarcer, then as the yoked ox is to-day.

Everybody Will Walk Ten Miles. Gymnastics will begin in the nursery, where toys and games will be designed to strengthen the muscles. Exercise will be compulsory in the schools. Every school, college and community will have a complete gymnasium. All cities will have public gymnasiums. A man or woman unable to walk ten miles at a stretch will be regarded as a weakling.

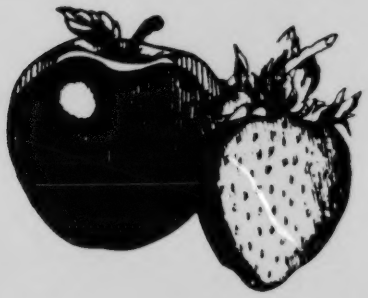
To England in Two Days. Fast electric ships, crossing the ocean at more than a mile a minute, will go from New York to Liverpool in two days. The bodies of these ships will be built above the waves. They will be supported upon runners, somewhat like those of the sleigh. These runners will be very buoyant. Upon their undersides will be apertures expelling jets of air. In this way a film of air will be kept between them and the water's surface. This film, together with the small surface of the runners, will reduce friction against the waves to the smallest possible degree. Propellers turned by electricity will screw themselves through both the water beneath and the air above. Ships with cabins artificially cooled will be entirely fire-

"The piano will be capable of changing its tone from cheerful to sad. Many devices will add to the emotional effect of music."

proof. In storm they will dive below the water and there await fair weather.

There Will Be Air-Ships, but they will not successfully compete with surface cars and water vessels for passenger or freight traffic. They will be maintained as deadly war-vessels by all military nations. Some will transport men and goods. Others will be used by scientists making observations at great heights above the earth.

Aerial War-Ships and Forts on Wheels. Giant guns will shoot twenty-five miles or more, and will hurl anywhere within such a radius shells exploding and destroying whole cities. Such guns will be aimed by aid of compasses when used on land or sea, and telescopes when directed from great heights. Fleets of air-ships, hiding themselves with dense, smoky mists, thrown off by themselves as they move, will float over cities, fortifications, camps or fleets. They will surprise foes below by hurling upon them deadly thunderbolts. These aerial war-ships will necessitate bomb-proof forts, protected by great steel plates over their tops as well as their sides. Huge forts on wheels will dash across open spaces at the speed of express trains of to-day. They will make what are now known as cavalry charges. Great automobile plows will dig deep intrenchments as fast as soldiers can occupy them. Rifles will use silent cartridges. Submarine boats submerged for days will be capable of wiping a whole navy off the face of the deep. Balloons and flying machines will carry telescopes of one-hundred-mile vision with camera attachments, photographing an enemy within that radius. These photographs, as distinct and large as if taken from across the street, will be lowered to the commanding officer in charge of troops below.



"Strawberries as large as apples . . . will be grown upon tall bushes."

CITY OF WILMINGTON, DELAWARE

"Automobiles will have been substituted for every horse vehicle now known [including] police patrols. . . ."

There Will Be No Wild Animals except in menageries. Rats and mice will have been exterminated. The horse will have become practically extinct. A few of high breed will be kept by the rich for racing, hunting and exercise. The automobile will have driven out the horse. Cattle and sheep will have no horns. They will be unable to run faster than the fattened hog of to-day. A century ago the wild hog could outrun a horse. Food animals will be bred to expend practically all of their life energy in producing meat, milk, wool and other by-products. Horns, bones, muscles and lungs will have been neglected.

Man Will See Around the World. Persons and things of all kinds will be brought within focus of cameras connected electrically with screens at opposite ends of circuits, thousands of miles at a span. American audiences in their theatres will view upon huge curtains before them the coronations of kings in Europe or the progress of battles in the Orient. The instrument bringing these distant scenes to the very doors of people will be connected with a giant telephone apparatus transmitting each incidental sound in its appropriate place. Thus the guns of a distant battle will be heard to boom when seen to blaze, and thus the lips of a remote actor or singer will be heard to utter words or music when seen to move.

Telephones Around the World. Wireless telephone and telegraph circuits will span the world. A husband in the middle of the Atlantic will be able to converse with his wife sitting in her boudoir in Chicago. We will be able to telephone to China quite as readily as we now talk from New York to Brooklyn. By an automatic signal they will connect with any circuit in their locality without the intervention of a "hello girl."

"There will be no wild animals except in menageries."

Grand Opera Will Be Telephoned to private homes, and will sound as harmonious as though enjoyed from a theatre box. Automatic instruments reproducing original airs exactly will bring the best music to the families of the untalented. Great

been born. To illustrate: if George Washington and Benjamin Franklin could have been transposed from the late eighteenth century to the early twentieth century, they probably would have suffered very little from future shock. Rural America in particular resembled much of the era in which they had lived. Only a few contrivances such as the telephone and the 13,824 automobiles registered in 1900 would have required much explanation.

In the last 40-odd years, however, a rapidly accelerating rate of change has combined with extraordinary technological progress. Biophysicist John Platt presents convincing evidence suggesting that in the past four decades there have been more profound changes than in the previous six centuries. As a result, virtually all adult Americans and many people everywhere have experienced a wrenching psychological and social disorientation that is changing the fabric of their lives and threatening their traditional cultures.

Without in any way demeaning the genius of John Elfreth Watkins, Jr., it seems likely to us that in the 1980s there are far more variables and "human unpredictables" than there were in 1900. At the very least, it now requires considerable temerity to forecast developments even 20 years hence—and Watkins's 100-year prognoses will, perhaps, never be replicated with such phenomenal accuracy. For that reason, we hope that John Elfreth Watkins, Jr., will be remembered as the "seer of the century" because of his extraordinarily accurate images of the world to which we have fallen heir.

About the Authors

Harold G. Shane is university professor of education at Indiana University, Bloomington. A pioneer in educational futurism, his recent books include *The Educational Significance of the Future* (1973), *Curriculum Change Toward the 21st Century* (1977), and *Educating for a New Millennium* ((1981).

Gary A. Sojka is professor of biology and dean of the College of Arts and Sciences at the same institution.

They can be reached through their respective departments, Indiana University, Bloomington, Indiana 47405.

musicians gathered in one inclosure in New York will, by manipulating electric keys, produce at the same time music from instruments arranged in theatres or halls in San Francisco or New Orleans, for instance. Thus will great bands and orchestras give long-distance concerts. In great cities there will be public opera-houses whose singers and musicians are paid from funds endowed by philanthropists and by the government. The piano will be capable of changing its tone from cheerful to sad. Many devices will add to the emotional effect of music.

"Rats and mice will have been exterminated."

How Children Will Be Taught. A university education will be free to every man and woman. Several great national universities will have been established. Children will study a simple English grammar adapted to simplified English, and not copied after the Latin. Time will be saved by grouping like studies. Poor students will be given free board, free clothing and free books if ambitious and actually unable to meet their school and college expenses. Medical inspectors regularly visiting the public schools will furnish poor children free eyeglasses, free dentistry and free medical attention of every kind. The very poor will, when necessary, get free rides to and from school and free lunches between sessions. In vacation time poor children will be taken on trips to various parts of the world. Etiquette and housekeeping will be important studies in the public schools.

Store Purchases by Tube. Pneumatic tubes, instead of store wagons, will deliver packages and bundles. These tubes will collect, deliver and transport mail over certain distances, perhaps for hundreds of miles. They will at first connect with the private houses of the wealthy; then with all homes. Great business establishments will extend them to stations, similar to our branch postoffices of to-day, whence fast automobile vehicles will distribute purchases from house to house.

Vegetables Grown by Electricity. Winter will be turned into summer and night into day by the farmer. In cold weather he will place heat-conducting electric wires under the soil of his garden and thus warm his growing plants. He will also grow large gardens under glass. At night his vegetables will be bathed in powerful electric light, serving, like sunlight, to hasten their growth. Electric currents applied to the soil will make valuable plants grow larger and faster, and will kill troublesome weeds. Rays of colored light will hasten the growth of many plants. Electricity applied to garden seeds will make them sprout and develop unusually early.

Oranges Will Grow in Philadelphia. Fast-flying refrigerators on land and sea will bring delicious

"Delicious oranges will be grown in the suburbs of Philadelphia."

"Mosquitoes, house-flies and roaches will have been practically exterminated."

fruits from the tropics and southern temperate zone within a few days. The farmer of South America, South Africa, Australia and the South Sea Islands, whose seasons are directly opposite to ours, will thus supply us in winter with fresh summer foods which cannot be grown here. Scientists will have discovered how to raise here many fruits now confined to much hotter or colder climates. Delicious oranges will be grown in the suburbs of Philadelphia. Cantaloups and other summer fruits will be of such a hardy nature that they can be stored through the winter as potatoes are now.

Strawberries As Large As Apples will be eaten by our great-great-grandchildren for their Christmas dinners a hundred years hence. Raspberries and blackberries will be as large. One will suffice for the fruit course of each person. Strawberries and cranberries will be grown upon tall bushes. Cranberries, gooseberries and currants will be as large as oranges. One cantaloup will supply an entire family. Melons, cherries, grapes, plums, apples, pears, peaches and all berries will be seedless. Figs will be cultivated over the entire United States.

Peas As Large As Beets. Peas and beans will be as large as beets are today. Sugar cane will produce twice as much sugar as the sugar beet now does. Cane will once more be the chief source of our sugar supply. The milkweed will have been developed into a rubber plant. Cheap native rubber will be harvested by machinery all over this country. Plants will be made proof against disease microbes just as readily as man is to-day against smallpox. The soil will be kept enriched by plants which take their nutrition from the air and give fertility to the earth.

Black, Blue and Green Roses. Roses will be as large as cabbage heads. Violets will grow to the size of orchids. A pansy will be as large in diameter as a sunflower. A century ago the pansy measured but half an inch across its face. There will be black, blue and green roses. It will be possible to grow any flower in any color and to transfer the perfume of a scented flower to another which is odorless. Then may the pansy be given the perfume of the violet.

Few Drugs Will Be Swallowed or taken into the stomach unless needed for the direct treatment of that organ itself. Drugs needed by the lungs, for instance, will be applied directly to those organs through the skin and flesh. They will be carried with the electric current applied without pain to the outside skin of the body. Microscopes will lay bare the vital organs, through the living flesh, of men and animals. The living body will to all medical purposes be transparent. Not only will it be possible for a physician to actually see a living, throbbing heart inside the chest, but he will be able to magnify and photograph any part of it. This work will be done with rays of invisible light.

©1900 by LHJ Publishing, Inc. Reprinted with permission of *Ladies' Home Journal*.

"Man will see around the world."

Harold G. Shane & Gary A. Sojka, October, 1982, *The Futurist*, published by the World Future Society, 4916 St. Elmo Avenue, Washington, D.C. 20014. Reprinted with permission.

The 21st Century: Squinting Into The Crystal Ball

IF EVER A TIME WAS RIGHT for painting images of the future, it is now. The desire to know what will happen next year, next decade, next century seems insatiable.

Business executives want solid predictions on population shifts, changes in consumer tastes and government policies. Investors seek assurances that the economic climate in the years ahead won't jeopardize hard-earned cash. Workers agonize over whether their choice of career will be a gateway to golden opportunity or a dead-end street.

Even in leisure, adults and children alike seem obsessed with the future. Youngsters play with "Star Wars" toys and videogames with names like Asteroids and Space Invaders. Science-fiction books are among the hottest sellers.

For the serious-minded, too, the past year has produced a flurry of books peering into the 21st century with such titles as *Megatrends, Encounters With the Future, The Coming Boom* and *Change! Seventy-One Glimpses of the Future.* All describe a future that offers the potential for more economic prosperity, social progress and scientific advancement than the world has ever known.

To get a glimpse of the future as portrayed in these books, *U.S.News & World Report* talked with three of the authors: Writer and scientist Isaac Asimov, futurist Herman Kahn and forecaster Marvin Cetron. Below they outline, in brief, their visions of what lies ahead for the U.S.

Isaac Asimov

Author, *Change! Seventy-One Glimpses of the Future*

Fifty years from now, more of the world's surface may be used for farms, parkland and wilderness because we will be moving considerable quantities of industry into space.

Factories that make all sorts of chemicals might do well in space because there we have the opportunity to make use of environments that are not natural on earth. In space, we have a virtually infinite supply of vacuum—for free. We have hard radiation from the sun, and if we shield things well, we can get low temperatures without much effort. You also have gravity-free conditions, which improve methods for mixing. And in the absence of air you can have better welding and so on.

In addition, you have a perfectly enormous sink for waste products that can be used indefinitely without fear. Here on earth all the wastes that you use must go into the biosphere—that section of the earth's surface in which living things exist. In space, waste is diluted a millionfold because of the enormous void, and the solar wind would tend to sweep away pollution into the outer solar system.

Now, there wouldn't be many people actually working in these space factories. By the time we get factories into orbit, we're going to have them thoroughly automated and robotized. We will be able to run them from a distance with only occasional visits by technicians. Of course, we have to have a more or less steady stream of raw materials entering and finished product leaving, but I dare say that can be arranged, too.

As far as people living in space, that depends on when we make the decision to establish power stations in orbit that are capable of absorbing solar radiation and converting it to electricity to be sent to earth. It wouldn't be too efficient to have people working on such stations who had to constantly commute from earth, so there will be a strong tendency to develop large space stations where dozens of people will live for months at a time.

Ahead: "A planetary society in which all human beings have a stake"

Isaac Asimov

If we start now, in 50 years I'd imagine we would have at least one of these stations in operation and a number of others being built.

I also look for the U.S., Russia and others to cooperate in such ventures because it would simply be too inefficient for countries to act on their own. The U.S. and the U.S.S.R. probably won't enjoy it, but I think that's the wave of the future: A planetary society in which all human beings have a stake.

On these space stations, people will spend their time building things, growing crops and tending animals. Others will supervise the activity of objects in space and run astronomical observatories and laboratories, or oversee the operation of mining stations on the moon.

It probably won't be until the 22nd century that these settlements are established enough to act as bases for further exploration into space. But the danger in such a prediction is that I'm too conservative, not sufficiently daring. Who would have imagined when the first airplane flew in 1903 that we would land on the moon 66 years later?

Herman Kahn

Author, *The Coming Boom*

The way I see it, the economic future of the U.S. looks mostly good over at least the next two decades. During that time, the country's gross national product should grow by an average of more than 3 percent each year, after adjusting for inflation. There are many reasons for this optimism: First of all, recovery from the current slump should be fairly sustained and strong because of cost cutting and better use of labor and equipment. Secondly, I see an end to the hostile and chaotic business environment of the last couple of decades. There will be less government regulation, an easing of inflation and a halt to escalating oil prices.

I expect enormous improvements in the labor force, which in the 1970s saw a big influx of women and young people. In the future, workers will be older, more experienced and better trained.

Eventually, too, you'll have revived investment in new plants and equipment that will make workers even more

Copyright © 1983, U.S.News & World Report, Inc.

productive. Once recovery begins, "supply side" economics will help that process along because lower tax rates will stimulate greater savings and thus create the funds business needs to expand and modernize.

Then there are the sweeping changes in the makeup of our economy. Service industries will continue to grow along with the information revolution, brought on by advances in the computer, automation and related technologies.

"I'm not sure how well the U.S. will handle being rich and secure"

Herman Kahn

Almost equal in importance will be breakthroughs in biotechnology, the development of new materials, and new methods of protecting the environment and conserving energy. We'll have carbon fibers that are a third of the weight of steel but much stronger and more easily shaped, for use in autos, airplanes and other goods.

Food and agriculture are going to move right ahead with development of crops that can tolerate salt water or grow in the desert. Space technology will boom, as will medicine and health services. New developments in transportation will continue to be an important part of the economy. We will have a pollution-free car with a choice of perhaps 10 different fuels—the first and foremost being an electric battery.

With all these developments, per capita income in the U.S. will double in the next 20 years. By 2050, the U.S. will have 4 percent of the world population and 10 percent of the gross world product, as opposed to 5 percent of the world population now and about 22 percent of world GNP. It's inevitable that the rest of the world will catch up some. Still, the U.S. and Japan will be the richest countries in gross national product 50 years from now, followed by the U.S.S.R. or China, France or West Germany, Brazil and Mexico. All will be over a trillion dollars—1980 dollars—in gross product.

However, being wealthy can create some problems. As people get richer, they often become less competitive, less interested in creating a dynamic environment. I'm not sure how well the U.S. will handle being rich and secure, but I fear we will rest on our laurels. If we look at the 1960s, when such conditions prevailed, there was an enormous amount of turmoil. People took the system for granted and thought it could withstand anything. That could happen again early in the next century.

Marvin Cetron

Author, With Thomas O'Toole, *Encounters With the Future*

Many of the social changes we will see in the U.S. over the next 50 years are being pioneered in Sweden. As in that country, the gap between the rich and poor will shrink as a paternalistic government takes away more in taxes for such things as Social Security, subsidies for education and insurance against catastrophic illnesses.

On other social matters, fathers will take paternity leave along with mothers, and children will be able to choose which parent they want to live with after a divorce. More people will live together before marrying, and women will voluntarily have children out of wedlock just for the experience of it.

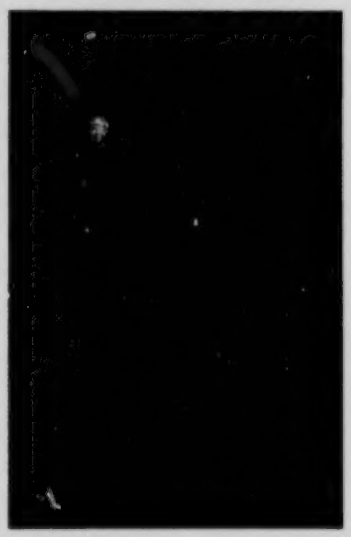
Longer life spans will mean more divorces. People won't put up with a mate they don't love for 60 or 70 years. As Margaret Mead used to predict, more people will marry three times: Once for love, once for children and once for companionship—though not necessarily in that order.

Such a matter as the equal-rights amendment won't even be an issue; it will be passed long before the year 2000, simply because older people who opposed it will have died off.

In careers, I expect more special college programs for bright students—whether these youngsters are needy or not. College will not be made available in the future for mediocre students because it will be too expensive. On the other hand, two-year community colleges with computers for job training will expand greatly.

"Who will determine whether to raise an IQ to 160?"

Marvin Cetron



Once people get in the labor force, they'll stay active and work longer. There will be all sorts of job shifting and job sharing.

In the next century, many people will change careers every 10 years. When you figure that in 75 percent of the cases both husband and wife will work, a family will be able to afford one of the spouses taking off to get retraining for the new job.

Because of great advances in computers and robots, the average work week will be just 20 hours shortly after the turn of the century, which will make leisure a huge industry.

In what will be a highly technical society, those who earn the most will be professional athletes, artists, writers, chefs and other creative people.

As always, people will debate moral issues, but there will be less willingness to let any group dictate rules and regulations. I look for more ecumenism in organized religion. One reason for that is the trend toward intermarriage among people of different faiths. At the present time, 40 percent of Catholics intermarry and about 33 percent of Jews do so, and the trend is increasing at the rate of 1 percent a year. Nothing forces people to take a more sensitive look at another faith than intermarriage.

Medical ethics will be a major social issue. In genetics, who will determine whether to raise an IQ to 160? Who will decide who gets certain wonder drugs—some 80-year-old Einstein or a 25-year-old woman with four children? It may take teams of professionals to answer such questions—not just a single doctor or clergyman. □

ACTIVITY 3

Predicting Your Own Future

At the beginning of this unit you read a scenario about life in the future. Will your life include work-at-home computers and robots as this episode suggests?

For this activity you will have to imagine that you are 70 years old. It is now the 21st century and you are looking back on your life. What was it like? What did you accomplish? What changes in the world did you observe?

Write a brief autobiography, from your perspective as a 70 year old, on the rest of this page (you may want to use additional paper, too). Be sure to describe how your lifestyle changed over the years. Apply the idea of a "Scotch Verdict" to each of your predictions.

Areas which each essay should include:

- *Growth in personal wealth over one's lifetime: cars, boats, personal computers, personal robots, property, etc.*
- *Changes in family relations: number of children, nuclear or extended family, divorce, remarriage, number of grandchildren or great-grandchildren, etc.*
- *Changes in occupation: career changes, improvements in technical expertise, effects of automation on one's job, length of time employed, things accomplished, etc.*
- *Changes in society: women's rights, advancement of minorities, more government involvement in one's life.*
- *Education: time spent in school, retraining for later job change, degree pursued, etc.*

There are other areas that students will pursue. For example, some students may use this assignment to write a science fiction essay. "Buck Rogers" adventures will require students to think through and relate separate technologies to their effects on lifestyle, as in the scenario at the beginning of this unit.

"Scotch Verdicts" should be ascribed to students' predictions. However, autobiographies that deal completely with fantasy are not inappropriate, as long as the essayist addresses the issue of probability of the events occurring as described.

The most insightful autobiographies will be those in which the student forces himself/herself out into the future, and must then grapple with changes and their consequences for his/her life.

UNIT TEST BANK

HOW TO THINK ABOUT THE FUTURE

1. Events that are just not possible, but are more likely to occur are parts of the _____ future. *(probable)*

2. We base predictions on the future upon what has happened in the past and on techniques to _____ the future. *(forecast)*

3. We can only be absolutely certain about events that _____. *(occurred in the past)*

4. When we base predictions upon past and current events, we are projecting a . . . *(c)*
   (a) divination (b) guess (c) trend (d) prophecy

5. When people state what they would like to happen, they are describing the _____ future. *(b)*
   (a) possible (b) preferable (c) probable (d) predicted

6. Astrologers, forecasters, and trend analysts are all different kinds of . . . *(c)*
   (a) leaders (b) scientists (c) prophets (d) meteorologists

7. Using the stars, tea leaves, or cards to foretell the future is called . . . *(c)*
   (a) witchcraft (b) trend analysis (c) divination (d) meteorology

8. Modern day prophets who use statistics to analyze trends are referred to as _____. *(forecasters)*

9. The less data and the further forecasters predict into the future, the _____ their forecasts tend to be. *(less reliable)*

10. A meteorologist predicts _____. (weather)

11. What is a "Scotch Verdict?" *(b)*
   (a) term in weather forecasting (b) level of certainty (c) false prediction (d) method of divination

12. If you are almost certain that something is true you could describe this as an example of . . . *(d)*
   (a) the preferable future (b) the probable future (c) divination (d) a Scotch Verdict

13. A prediction of tomorrow's weather can be considered to be the . . . *(d)*
   (a) possible future (b) probable future (c) preferable future (d) a, b and c

14. When you vote for a candidate, you are expressing your . . . *(c)*
   (a) possible future (b) probable future (c) preferable future (d) a, b and c

ACTIVITIES: THE GREAT TRANSITION

ACTIVITY 4

THE GREAT TRANSITION

In every country, three changes occur during the transition from a pre-industrialized economy to industrialization. These changes are described in your text. If you don't recall the changes, take a few moments to review them. Then, write each type of change below.

- Change 1: *Growth in population*
- Change 2: *Increase in wealth*
- Change 3: *Increase in control over the forces of nature*

How big are these changes? Use the graphs and tables to make the following comparisons of the United States before and after industrialization.

	Pre-Industrialized U.S. (1850)	Industrialized U.S. (1950)
Number of people (Chart 1)	*23,191,876*	*150,697,361*
Number of people living in cities (Charts 2-A and 2-B)	*3,544,000*	**96,468,000*
Number of people living in rural areas (Charts 2-A and 2-B)	*19,648,000*	*54,230,000*
Number in labor force working in manufacturing (Chart 3)	*1,200,000*	*15,648,000*
Number in labor force in agriculture (Chart 3)	*4,520,000*	*7,870,000*
Gross National Product (Chart 4)	1869: $ ***7.4* billion	$ *284.8* billion
Infant mortality rate (for example in Massachusetts) (Chart 5)	*131.1* per 1,000 live births	*22.8* per 1,000 live births
Life expectancy at birth (for example in Massachusetts) (Chart 6)	****38.4/ 40.5* years	*66.7/ 72.1* years

* *Use "1950 urban definition." It means the Census Bureau changed their definition for what constitutes an "urban" area.*

** *Use current prices, since normalization did not occur on this chart until 1958. Point out the difference between "current" and "1958" prices, which illustrates inflation's impact.*

*** *Have them list expectancy for both males and females.*

BEST COPY AVAILABLE

Chart 1

NOTE: Make sure to add the numbers in both the male and female columns to determine total population.

POPULATION

Series A 91–104. Population, by Sex and Race: 1790 to 1970

Year	Male							Female						
	All races	White	Negro [1]	Other races				All races	White	Negro [1]	Other races			
				Total [2]	Indian	Japanese	Chinese				Total [2]	Indian	Japanese	Chinese
	91	92	93	94	95	96	97	98	99	100	101	102	103	104
1970 [3]	96,912,192	86,720,987	10,748,816	1,442,389	388,691	271,300	228,565	104,299,734	91,027,988	11,831,978	1,439,773	404,089	319,990	206,497
1960 [4]	88,331,494	78,867,149	9,118,406	850,927	283,369	224,328	135,549	90,991,681	80,464,583	9,758,423	768,675	260,222	239,504	101,748
1950	87,864,510	78,153,040	9,105,702	605,768	255,677	124,323	115,849	90,599,726	80,301,916	9,754,415	543,395	252,998	135,736	83,160
1940	74,533,239	67,129,192	7,298,722	406,325	178,824	76,549	77,008	75,864,122	67,812,836	7,743,564	307,722	164,586	65,119	40,921
1930	66,061,592	59,448,548	6,289,038	344,006	171,427	71,567	57,389	65,607,683	58,766,322	6,596,480	244,881	162,542	54,980	20,116
1920	62,137,080	55,922,528	5,855,669	358,883	170,350	81,771	59,802	60,637,966	54,364,212	6,035,474	238,280	162,047	57,068	15,152
1910	53,900,431	48,430,655	5,209,436	260,340	125,063	72,707	53,891	51,810,189	46,390,260	5,253,695	166,234	119,369	33,308	7,748
1900	47,332,277	42,178,245	4,885,881	268,151	135,133	63,070	66,856	44,639,989	39,553,712	4,941,882	144,395	130,550	9,087	4,675
1890	38,816,448	34,201,735	4,386,547	228,166	117,484	28,341	85,341	37,178,127	32,607,461	4,447,447	123,219	117,713	985	4,522
1880	32,237,101	28,270,379	3,735,608	231,119	125,719	1,790	103,620	30,710,618	26,930,879	3,758,978	126,661	122,584	289	3,868
1870 [4]	25,518,820	22,130,900	3,253,115	134,805	33,985	154	100,666	24,534,943	21,272,070	3,227,678	37,215	23,423	14	4,779
1860	19,493,565	17,029,088	2,393,268	71,214	12,534	47	58,633	19,064,806	16,560,289	2,486,746	17,771	13,197	8	4,566
1850	16,085,204	13,811,387	2,216,744	57,073	23,924	------	33,149	15,558,117	13,111,150	2,225,086	21,881	20,097	------	1,784
1840	11,837,660	10,026,402	1,811,258	------	------	------	------	11,354,216	9,526,666	1,827,550	------	------	------	------
	8,688,522	7,255,644	1,432,988	------	------	------	------	8,380,921	6,940,261	1,440,660	------	------	------	------
1830	6,532,489	5,366,218	1,166,276	------	------	------	------	6,333,581	5,171,165	1,162,366	------	------	------	------
1820	4,896,605	3,995,809	900,796	------	------	------	------	4,741,848	3,870,988	870,860	------	------	------	------
1810	(5)	2,988,130	(5)	------	------	------	------	(5)	2,873,943	(5)	------	------	------	------
1800	(5)	2,195,305	(5)	------	------	------	------	(5)	2,111,141	(5)	------	------	------	------
1790	(5)	1,615,434	(5)	------	------	------	------	(5)	1,556,572	(5)	------	------	------	------

Chart 2-A

Shown in "Thousands." *3,544* in this table means *3,544,000* (1000 x 3,544).

A 57–81

POPULATION

Series A 57–72. Population in Urban and Rural Territory, by Size of Place: 1790 to 1970—Con.

[In thousands]

Series No.	Class and population size	1890	1880	1870 [1]	1860	1850 [1]	1840 [1]	1830	1820	1810	1800	1790
57	Urban territory	22,106	14,130	9,902	6,217	3,544	1,845	1,127	693	525	323	202
58	Places of 1,000,000 or more	3,662	1,206	------	------	------	------	------	------	------	------	------
59	Places of 500,000–999,999	806	1,917	1,616	1,879	616	------	------	------	------	------	------
60	Places of 250,000–499,999	2,448	1,301	1,524	267	–	318	------	------	------	------	------
61	Places of 100,000–249,999	2,782	1,787	990	923	659	205	203	134	------	------	------
62	Places of 50,000–99,999	2,028	948	768	452	284	187	222	127	150	61	------
63	Places of 25,000–49,999	2,269	1,446	930	670	411	235	105	70	80	68	62
64	Places of 10,000–24,999	3,451	2,189	1,710	884	561	405	240	122	109	84	48
65	Places of 5,000–9,999	2,384	1,717	1,278	976	596	329	231	155	116	94	48
66	Places of 2,500–4,999	2,277	1,618	1,086	595	316	172	126	96	70	45	44
69	Rural territory	40,841	36,026	28,656	25,227	19,648	15,224	11,739	8,945	6,714	4,986	3,728
70	Places of 1,000–2,499	2,509	------	------	------	------	------	------	------	------	------	------
71	Places under 1,000	2,249	------	------	------	------	------	------	------	------	------	------
72	Other rural territory	36,083	------	------	------	------	------	------	------	------	------	------

BEST COPY AVAILABLE

Chart 2-B

Shown in Thousands. (*96,468* means *96,468,000*).

Series A 57–72. Population in Urban and Rural Territory, by Size of Place: 1790 to 1970

[In thousands. For U.S. total population, see series A 2. For definition of urban, see text for series A 43–56]

Series No.	Class and population size	1970 [1]	1960		1950		1940	1930	1920	1910	1900
			Including Alaska and Hawaii	Conterminous United States	1950 urban definition	1940 urban definition					
57	Urban territory	149,325	125,269	124,699	96,468	88,927	74,424	68,955	54,158	41,999	30,160
58	Places of 1,000,000 or more	18,769	17,484	17,484	17,404	17,404	15,911	15,065	10,146	8,501	6,429
59	Places of 500,000–999,999	13,967	11,111	11,111	9,187	9,187	6,457	5,784	6,224	3,011	1,648
60	Places of 250,000–499,999	10,442	10,766	10,472	8,242	8,242	7,822	7,956	4,541	3,950	2,861
61	Places of 100,000–249,999	14,286	11,652	11,652	9,479	9,614	7,793	7,541	6,519	4,840	3,272
62	Places of 50,000–99,999	16,724	15,836	15,836	8,931	9,078	7,844	6,491	5,265	4,179	2,706
63	Places of 25,000–49,999	17,848	14,951	14,855	8,808	9,496	7,417	6,426	5,075	4,023	2,801
64	Places of 10,000–24,999	21,415	17,568	17,513	11,867	12,467	9,967	9,097	7,035	5,549	4,338
65	Places of 5,000–9,999	12,924	9,780	9,739	8,139	7,879	6,682	5,897	4,968	4,217	3,204
66	Places of 2,500–4,999	8,038	7,580	7,542	6,490	5,565	5,026	4,718	4,386	3,728	2,899
67	Places under 2,500	727	690	690	578						
68	Other urban territory	15,186	9,851	9,806	7,344						
69	Rural territory	53,857	54,054	53,765	54,230	61,770	57,246	53,830	51,553	49,973	45,835
70	Places of 1,000–2,499	6,656	6,497	6,440	6,473	5,883	5,027	4,821	4,712	4,234	3,236
71	Places under 1,000	3,852	3,894	3,888	4,081	4,129	4,316	4,363	4,255	3,930	3,008
72	Other rural territory	43,379	43,664	42,437	43,735	52,258	47,903	44,637	42,586	41,809	39,533

Chart 3

Shown in thousands.

LABOR FORCE

Series D 167–181. Labor Force and Employment, by Industry: 1800 to 1960

[In thousands of persons 10 years old and over]

Year	Labor force			Employment										
								Manufacturing				Transport		Service	
	Total	Free	Slave	Agriculture	Fishing	Mining	Construction	Total persons engaged	Cotton textile wage earners	Primary iron and steel wage earners	Trade	Ocean vessels	Railway	Teachers	Domestics
	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181
1960	74,060			5,970	45	709	3,640	17,145	300	530	14,051	135	883	1,850	2,489
1950	65,470			7,870	77	901	3,029	15,648	350	550	12,152	130	1,373	1,270	1,995
1940	56,290			9,575	60	925	1,876	11,309	400	485	9,328	150	1,160	1,086	2,300
1930	48,830			10,560	73	1,009	1,988	9,884	372	375	8,122	160	1,659	1,044	2,270
1920	41,610			10,790	53	1,180	1,233	11,190	450	460	5,845	205	2,256	752	1,680
1910	37,480			11,770	68	1,068	1,949	8,332	370	306	5,320	150	1,855	596	2,090
1900	29,070			11,680	69	637	1,665	5,895	303	222	3,970	105	1,040	436	1,900
1890	23,320			9,960	60	440	1,510	4,390	222	149	2,960	120	750	350	1,580
1880	17,390			8,920	41	280	900	3,290	175	130	1,930	125	416	230	1,130
1870	12,930			6,790	28	180	780	2,470	135	78	1,310	135	160	170	1,000
1860	11,110	8,770	2,340	5,880	31	176	520	1,530	122	43	890	145	80	115	900
1850	8,250	6,280	1,970	4,520	30	102	410	1,200	92	35	530	135	20	80	350
1840	5,660	4,180	1,480	3,570	24	32	290	500	72	24	350	95	7	45	240
1830	4,200	3,020	1,180	2,965	15	22		(NA)	55	20		70		30	160
1820	3,135	2,185	950	2,470	14	13		(NA)	12	5		50		20	110
1810	2,330	1,590	740	1,960	6	11		75	10	5		60		12	70
1800	1,900	1,370	530	1,400	5	10			1	1		40		5	40

NA Not available.

Series F 1–5. Gross National Product, Total and Per Capita, in Current and 1958 Prices: 1869 to 1970

Year	Current prices		1958 prices		Implicit price index (1958 = 100)	Year	Current prices		1958 prices		Implicit price index (1958 = 100)
	Total	Per capita	Total	Per capita			Total	Per capita	Total	Per capita	
	1	2	3	4	5		1	2	3	4	5
	Bil. dol.	*Dollars*	*Bil. dol.*	*Dollars*			*Bil. dol.*	*Dollars*	*Bil. dol.*	*Dollars*	
1970	977.1	4,808	722.5	3,555	135.2	1928	97.0	805	190.9	1,584	50.8
1969	930.3	4,590	725.6	3,580	128.2	1927	94.9	797	189.8	1,594	50.0
1968	864.2	4,306	706.6	3,521	122.3	1926	97.0	826	190.0	1,619	51.1
1967	793.9	3,995	675.2	3,398	117.6						
1966	749.9	3,815	658.1	3,348	113.9	1925	93.1	804	179.4	1,549	51.9
						1924	84.7	742	165.5	1,450	51.2
1965	684.9	3,525	617.8	3,180	110.9	1923	85.1	760	165.9	1,482	51.3
1964	632.4	3,296	581.1	3,028	108.8	1922	74.1	673	148.0	1,345	50.1
1963	590.5	3,120	551.0	2,912	107.2	1921	69.6	641	127.8	1,177	54.5
1962	560.3	3,004	529.8	2,840	105.8						
1961	520.1	2,831	497.2	2,706	104.6	1920	91.5	860	140.0	1,315	65.4
						1919	84.0	804	146.4	1,401	57.4
1960 [2]	503.7	2,788	487.7	2,699	103.3	1918	76.4	740	151.8	1,471	50.3
1959	483.7	2,731	475.9	2,688	101.6	1917	60.4	585	135.2	1,310	44.7
1958	447.3	2,569	447.3	2,569	100.0	1916	48.3	473	134.3	1,317	36.0
1957	441.1	2,576	452.5	2,642	97.5						
1956	419.2	2,492	446.1	2,652	94.0	1915	40.0	398	124.5	1,238	32.1
						1914	38.6	389	125.6	1,267	30.7
1955	398.0	2,406	438.0	2,650	90.9	1913	39.6	407	131.4	1,351	30.1
1954	364.8	2,247	407.0	2,506	89.6	1912	39.4	413	130.2	1,366	30.3
1953	364.6	2,285	412.8	2,587	88.3	1911	35.8	382	123.2	1,313	29.1
1952	345.5	2,201	395.1	2,517	87.5						
1951	328.4	2,129	383.4	2,486	85.6	1910	35.3	382	120.1	1,299	29.4
						1909	33.4	369	116.8	1,290	28.6
1950	284.8	1,877	355.3	2,342	80.2	1908	27.7	312	100.2	1,130	27.6
1949	256.5	1,719	324.1	2,172	79.1	1907	30.4	349	109.2	1,255	27.8
1948	257.6	1,757	323.7	2,208	79.6	1906	28.7	336	107.5	1,258	26.7
1947	231.3	1,606	309.9	2,150	74.6						
1946	208.5	1,475	312.6	2,211	66.7	1905	25.1	299	96.8	1,149	26.1
						1904	22.9	279	89.7	1,092	25.6
1945	211.9	1,515	355.2	2,538	59.7	1903	22.9	284	90.8	1,126	25.2
1944	210.1	1,518	361.3	2,611	58.2	1902	21.6	273	86.5	1,093	24.9
1943	191.6	1,401	337.1	2,465	56.8	1901	20.7	267	85.7	1,105	24.1
1942	157.9	1,171	297.8	2,208	53.0						
1941	124.5	934	263.7	1,977	47.2	1900	18.7	246	76.9	1,011	24.3
						1899	17.4	233	74.8	1,000	23.2
1940	99.7	754	227.2	1,720	43.9	1898	15.4	210	68.6	933	22.4
1939	90.5	691	209.4	1,598	43.2	1897	14.6	202	67.1	930	21.8
1938	84.7	651	192.9	1,484	43.9	1896	13.3	188	61.3	865	21.7
1937	90.4	701	203.2	1,576	44.5						
1936	82.5	643	193.0	1,506	42.7	1895	13.9	200	62.6	900	22.3
						1894	12.6	185	56.9	819	22.6
1935	72.2	567	169.5	1,331	42.6	1893	13.8	206	57.5	859	24.1
1934	65.1	514	154.3	1,220	42.2	1892	14.3	218	60.4	920	23.6
1933	55.6	442	141.5	1,126	39.3	1891	13.5	210	55.1	856	24.6
1932	58.0	465	144.2	1,154	40.2						
1931	75.8	611	169.3	1,364	44.8	1890	13.1	208	52.7	836	24.9
						1889	12.5	202	49.1	796	25.4
1930	90.4	734	183.5	1,490	49.3	1879–1888 [1]	11.2	205	42.4	774	26.5
1929	103.1	847	203.6	1,671	50.6	1869–1878 [1]	7.4	170	23.1	531	32.1

Chart 5

Series B 148. Infant Mortality Rate, for Massachusetts: 1851 to 1970

[Deaths under 1 year per 1,000 live births. Excludes fetal deaths. Data for 1940 to 1968 are by place of residence; for other years, by place of occurrence]

Year	Rate	Year or period	Rate	Period	Rate	Period	Rate
	148		148		148		148
1970	16.8	1961	21.6	1940–44	34.3	1895–99	153.3
1969	18.3	1960	21.6	1935–39	43.2	1890–94	163.3
1968	19.9	1959	22.3	1930–34	53.9	1885–89	156.5
1967	20.0	1958	22.8	1925–29	67.6	1880–84	161.3
1966	21.2	1957	22.7	1920–24	78.7	1875–79	156.3
1965	22.2	1956	22.4	1915–19	100.2	1870–74	170.3
1964 [3]	19.8	1955	21.9	1910–14	116.7	1865–69	146.3
1963	20.6	1950–54	22.8	1905–09	134.3	1860–64	142.5
1962	21.8	1945–49	23.4	1900–04	141.4	1855–59	132.9
						1851–54	131.1

BEST COPY AVAILABLE

Chart 6

Series B 126–135. Expectation of Life at Specified Ages, by Sex, for Massachusetts: 1850 to 1949–51

(In years)

Year or period	At birth		Age 20		Age 40		Age 60		Age 70	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	126	127	128	129	130	131	132	133	134	135
1949–51	66.7	72.1	49.3	54.2	30.7	35.2	15.4	18.3	9.9	11.6
1939–41 [1]	63.3	67.6	47.4	51.0	29.3	33.6	14.5	16.4	9.1	10.2
1929–31 [1]	59.3	62.6	46.1	48.5	29.0	31.2	14.3	15.3	8.9	9.9
1919–20 [1]	54.1	56.6	44.6	45.5	28.3	30.0	14.4	15.4	8.9	9.6
1909–11	49.3	53.1	42.5	44.9	27.0	29.0	13.4	14.8	8.6	9.5
1900–02	46.1	49.4	41.8	43.7	27.2	28.8	13.9	15.1	8.9	9.6
1893–97	44.1	46.6	41.2	42.8	27.4	29.0	14.4	15.7	9.3	10.4
1890	43.5	44.5	40.7	42.0	27.4	28.8	14.7	15.7	9.4	10.2
1878–82	41.7	43.5	42.3	42.8	28.9	30.3	15.6	16.9	10.3	11.3
1855	38.7	40.9	39.8	39.9	27.0	28.8	14.4	15.6	(NA)	(NA)
1850	38.3	40.6	40.1	40.2	27.9	29.8	15.6	17.0	10.3	11.3

BEST COPY AVAILABLE

ACTIVITY 5

LOOKING BACK, LOOKING AHEAD

Seven periods of U.S. history are listed below. For *each* period, do library research to answer questions 1–5 that follow. Some good sources of information are: *Historical Statistics of the United States, America in Time,* or any general encyclopedia. Your librarian can lead you to other sources.

1. How many people were there?
2. What, if any, industries were there?
3. What was the role of agriculture?
4. How did most people earn their money?
5. What major things were invented during this period?

The Early Colonial Period (around 1630):

1. *People: 52,000*
2. *Industries: none in colonies. Raw materials shipped to England; shipbuilding.*
3. *Agriculture: subsistence farming, towards commercial farming (for trade).*
4. *Income; farming, trade, trapping, fishing, forestry*
5. *Inventions: few; had little economic application.*

The First Federal Years (around 1790):

1. *People: 3,900,000*
2. *Industries: guns, ships, textiles, manufacturing*
3. *Agriculture: plantations (slavery), small farms*
4. *Income: farming, commerce, trade, manufacturing, forestry (self-sufficiency)*
5. *Inventions: steam engine, smelter, spinning jenny, cotton gin, railroad*

Civil War Times (around 1860):

1. *People: 31,400,000 (4,000,000 slaves)*
2. *Industries: iron foundries, textile, armaments, ships, mills*
3. *Agriculture: cash crops in North. Plantations in South (cotton).*
4. *Income: mining, farming, trade, commerce, ranching, railroads, cotton*
5. *Inventions: telegraph, sewing machine, reaper, steel plow*

The Roaring 20's (around 1925):

1. *People: 105,700,000*
2. *Industries: armaments, textile, automobile, shipbuilding*
3. *Agriculture: fewer small farms, tremendous productivity*
4. *Income: commerce, manufacturing, transportation, investment*
5. *Inventions: automobile, synthetic fibers, television, iron lung, airplanes*

World War II (1940-1945):

1. *People: 131,600,000*
2. *Industries: armaments, heavy industry, automobiles, technology*
3. *Agriculture: fewer farms, larger size, greater productivity*
4. *Income: construction, manufacturing, commerce, transportation services*
5. *Inventions: atom bomb, guided missle, computer, color TV*

Modern Times (since about the time of your birth — 1970–present):

1. *People: 203,200,000*
2. *Industries: high technology, manufacturing, tourism, information processing, services*
3. *Agriculture: small number of farmers feed entire country, and world exports*
4. *Income: services, information, high technology, manufacturing, tourism, government*
5. *Inventions: bioengineering, space shuttle, high speed computers, videogames*

The Near Future (the 1980's):

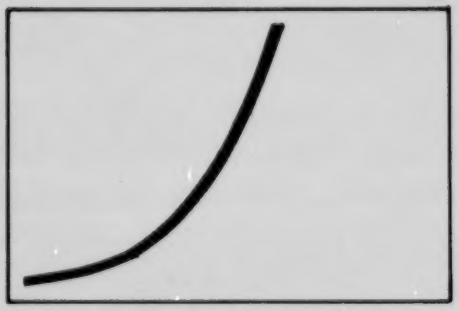
1. *People: 250,000,000*
2. *Industries: tourism, information, high technology, manufacturing, space development*
3. *Agriculture: use even less land, water and people to produce even more food*
4. *Income: investment, services, government, high technology, small businesses*
5. *Inventions: cure for cancer, 5th generation "smart" computer, pollution-free car*

ACTIVITY 6

CURVES: SHOWING CHANGE VISUALLY

To understand changes (for example, changes in population growth) it is necessary to think like a mathematician. The charts below will help you understand this. It is important to know how to read these charts and to understand "chart vocabulary."

J—SHAPED (Increasing)



J-shaped curves show a trend that starts slowly and then increases rapidly with no indication of reversal. When it increases rapidly at a constant ***rate,*** it is called an "exponential" curve.

J—SHAPED (Decreasing)

Reversed J-shaped curves start slowly and then decrease rapidly. When it decreases rapidly by a constant ***rate,*** it is called an "exponential" curve.

S—SHAPED CURVE

S-shaped curves indicate a trend that started slowly, went through a phase of rapid change, and started to slow down at some point. This curve depicts the course of many natural developments.

SPIKE CURVE

Spike curves indicate a trend that maintains a low level, then takes a very rapid increase and a rapid decrease, and then remains at about the same level as before the increase.

For each of the following charts or graphs decide which kind of change curve is illustrated. Check "S-shaped," "J-shaped (Increasing)," "J-shaped (Decreasing)," or "Spike."

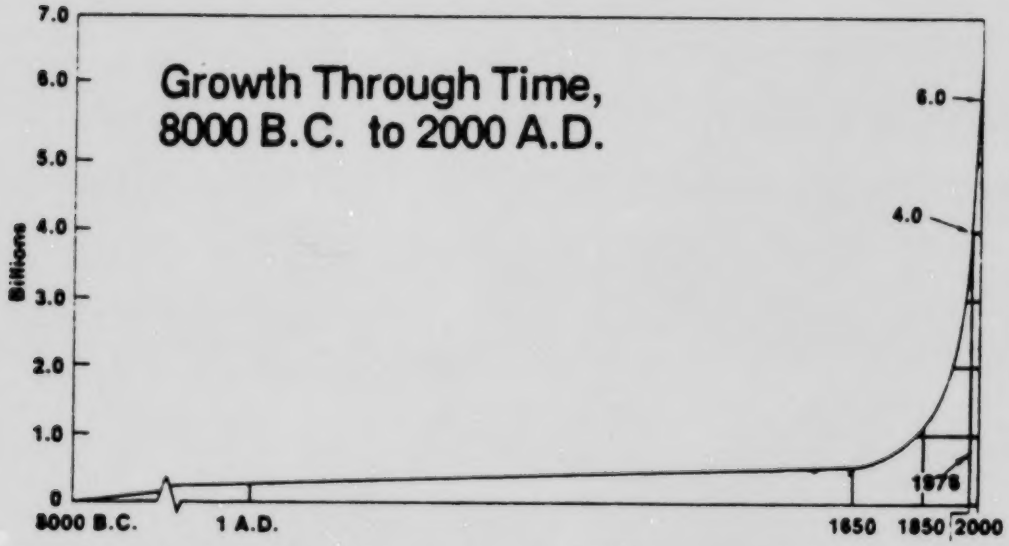


Figure 4.2. Growth through time, 800 B.C. to 2000 A.D. (Source. Population Reference Bureau, Inc., 1746 N Street, N.W. Washington, D.C. 20036.)

S-shaped____ J-shaped (Increasing)_X_ J-shaped (Decreasing)____ or Spike____

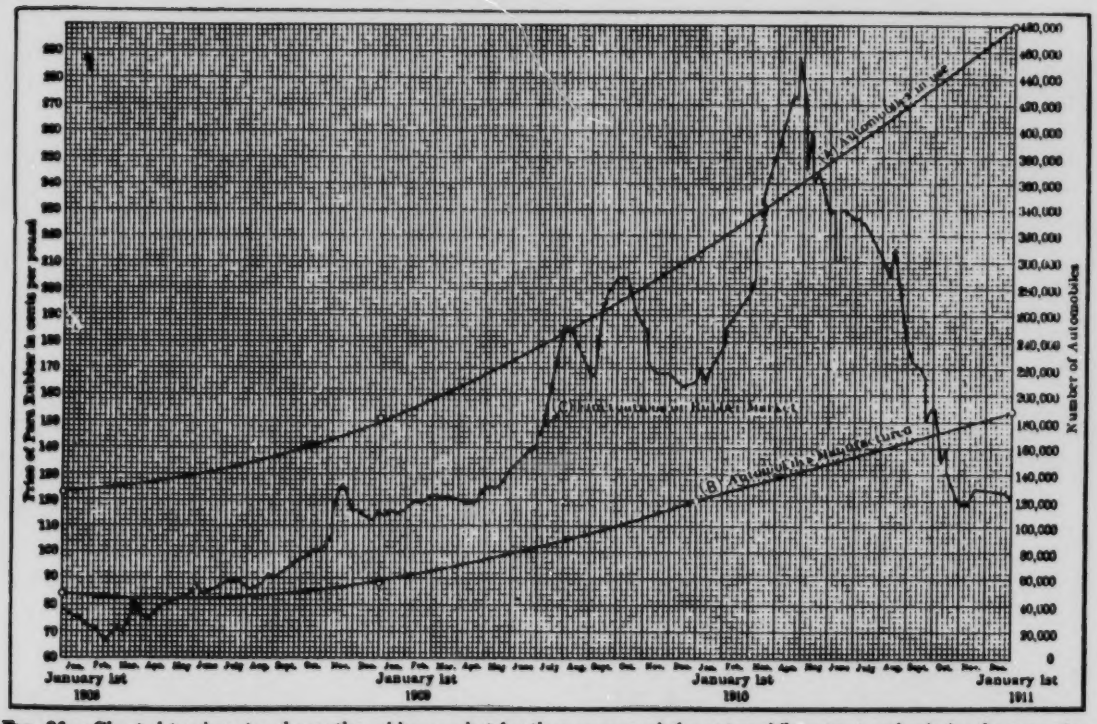
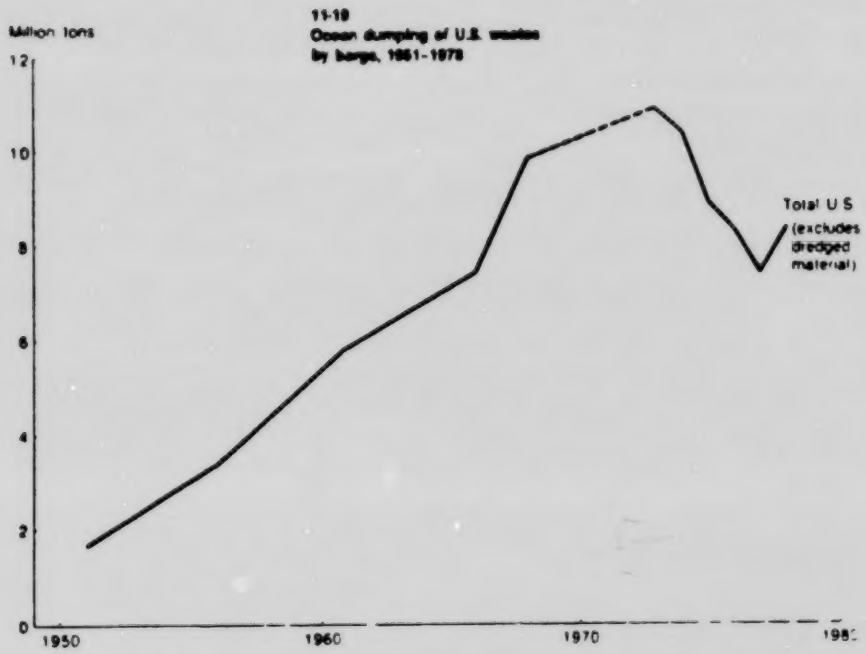


FIG. 86.—Charted to give at a glance the rubber market for three years and the automobile output and sale for the same time.

S-shaped____ J-shaped (Increasing)____ J-shaped (Decreasing)____ or Spike_X_

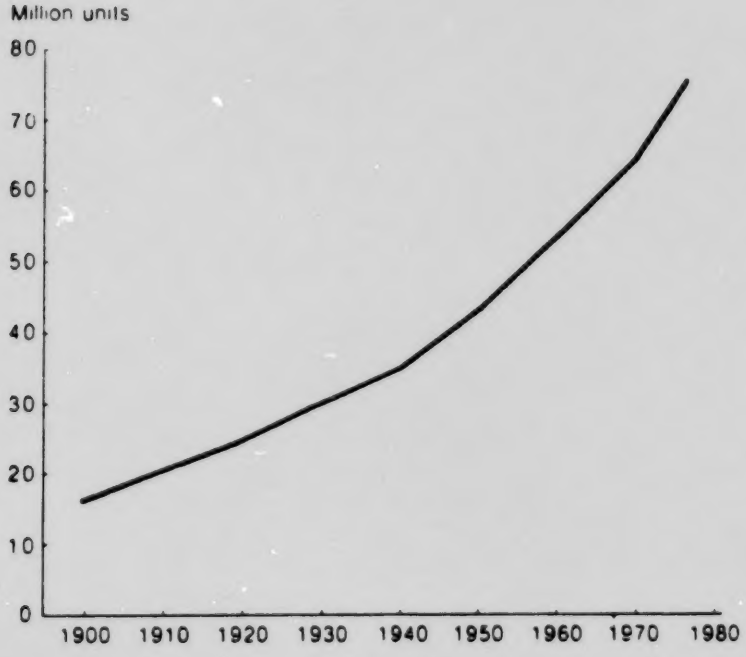
APPLICATIONS

BEST COPY AVAILABLE

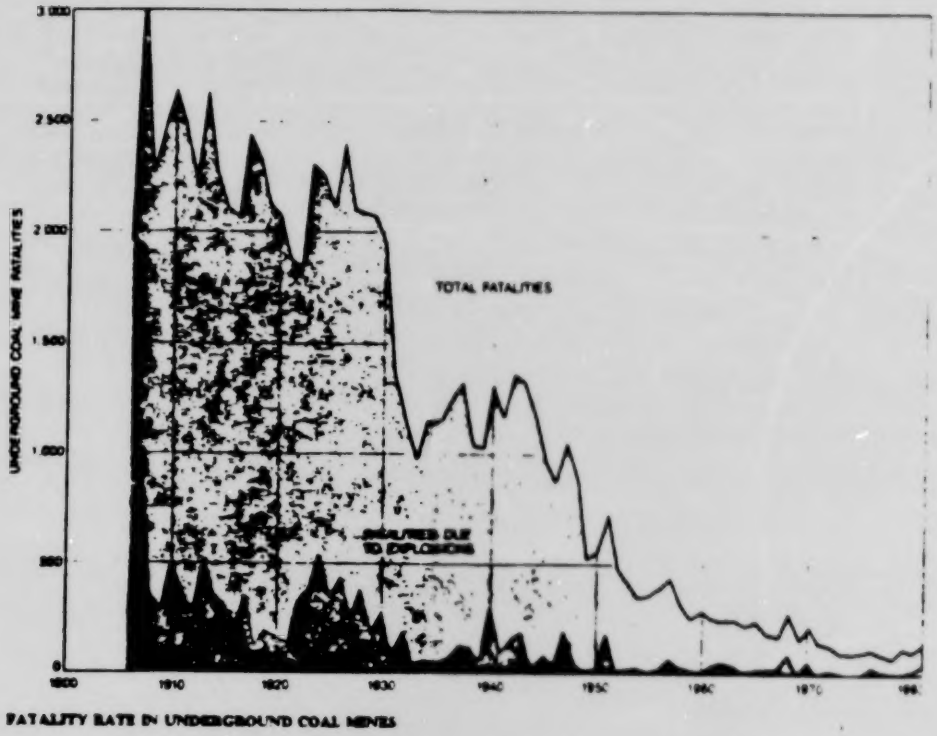


S-shaped X J-shaped (Increasing)____ J-shaped (Decreasing)____ or Spike____

Occupied housing units, 1900-1977



S-shaped____ J-shaped (Increasing) X J-shaped (Decreasing)____ or Spike____



S-shaped____ J-shaped (Increasing)____ J-shaped (Decreasing)_X_ or Spike____

BEST COPY AVAILABLE

ACTIVITY 7

EXPONENTIALITY

Mathematicians call one type of very rapid growth rate "exponential," from the word "exponent." Exponents (or powers as they are sometimes called) are simple ways of showing multiplication. Using exponents, if you want to show that the number 5 is multiplied by itself 4 times, you would write 5^4. This is the same as saying 5x5x5x5. The 5 is the number that will be multiplied and the 4 — the exponent or power — is the number of times it will be multiplied. The answer would be 5x5 = 25x5 = 125x5 = 625. You can see that exponential growth can be very rapid and constant.

Another example of how to think about exponential growth could be a plan for saving money. Suppose you want to double your savings every day for two weeks. (Doubling something is a 100% increase.) Assume that you are able to start on the first day with a savings of *2 cents* obtained in change at lunch. Your goal is to save twice the amount each day as you had the previous day. On the second day you would have to save 4 cents (2x2), on the third day you would need to save 8 cents (2x2x2), and so on until the 14th day. The solid line on the chart on the next page shows the amounts you would need to save each day. Do you think you could carry out this savings program through day 14? Could you save the amount on day 7 without much trouble? Probably not, so it makes sense to consider changing the *rate* of your savings.

How much do you need to save on day 7?

70.4 (increase of 10%: 64 pennies + 10% = 70.4)

How much on day 14?

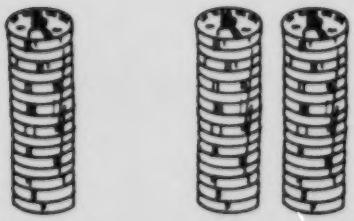
137 pennies (note: "compound" each day's savings)

DOUBLING YOUR SAVINGS

DAY 1

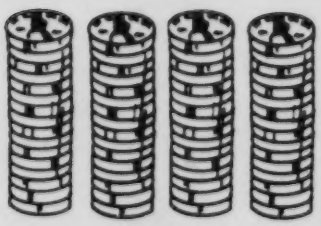
DAY 2

DAY 3

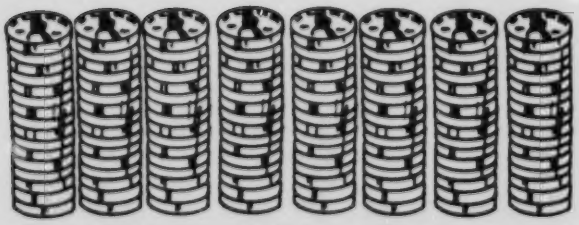


DAY 4

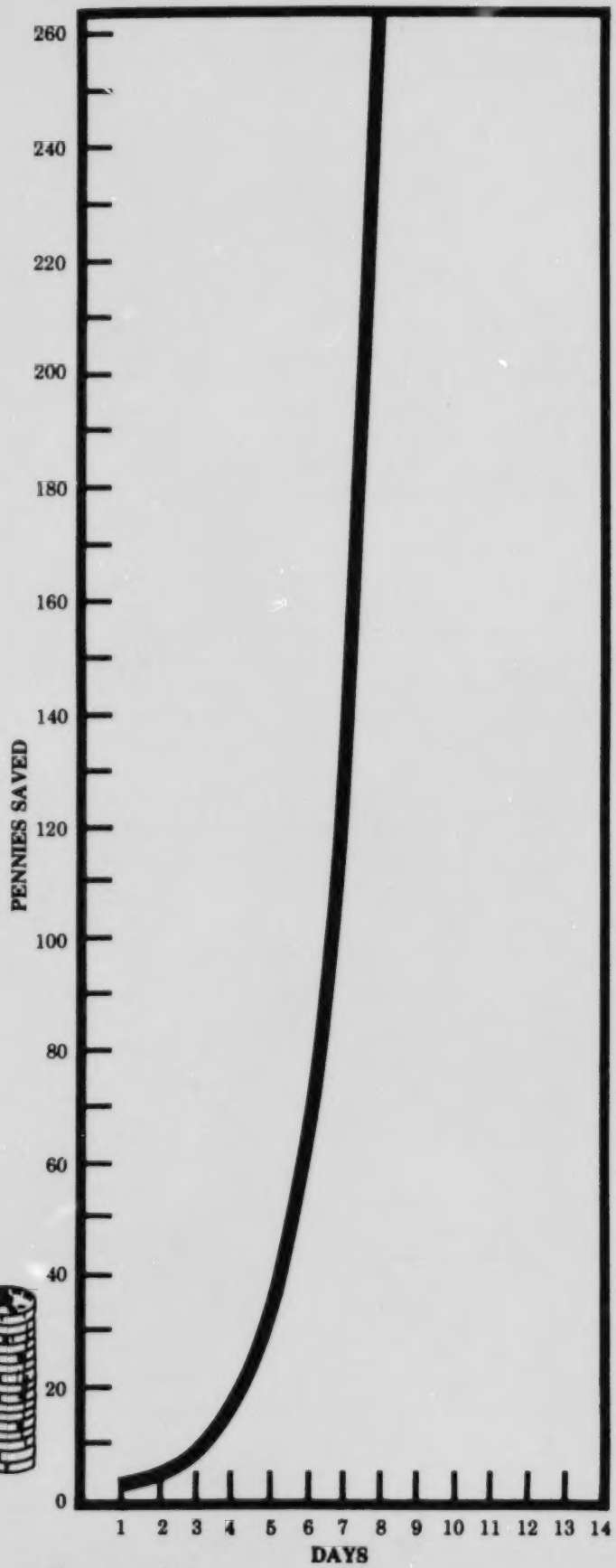
DAY 5



DAY 6



DAY 7

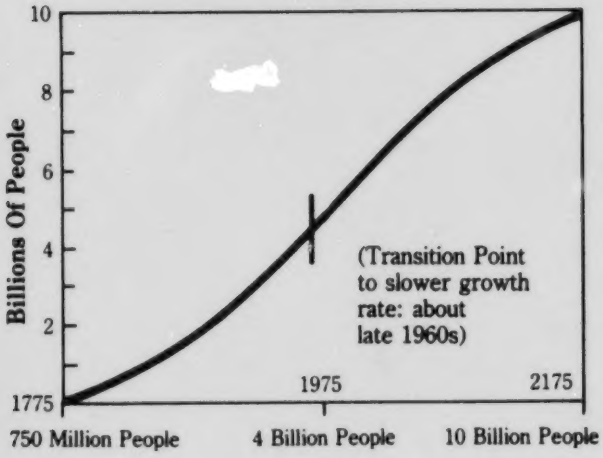


If on day 6 you could no longer afford to double your savings, you might choose to increase your savings by only one-tenth (or 10%) each day. With this new savings plan, how much do you now need to save on day 7? How much on day 14? Note that the dotted line on the chart at the right shows the different amounts you need to save when you change the *rate* of growth to the 10% per day you originally decided on. With the 10 percent plan you still save more pennies each day, so the *amount* of pennies increases, but they accumulate at a very different, and much slower, *rate* than with the 100 percent plan. Many kinds of growth, including population growth, can follow the same patterns, except of course that population can also decline.

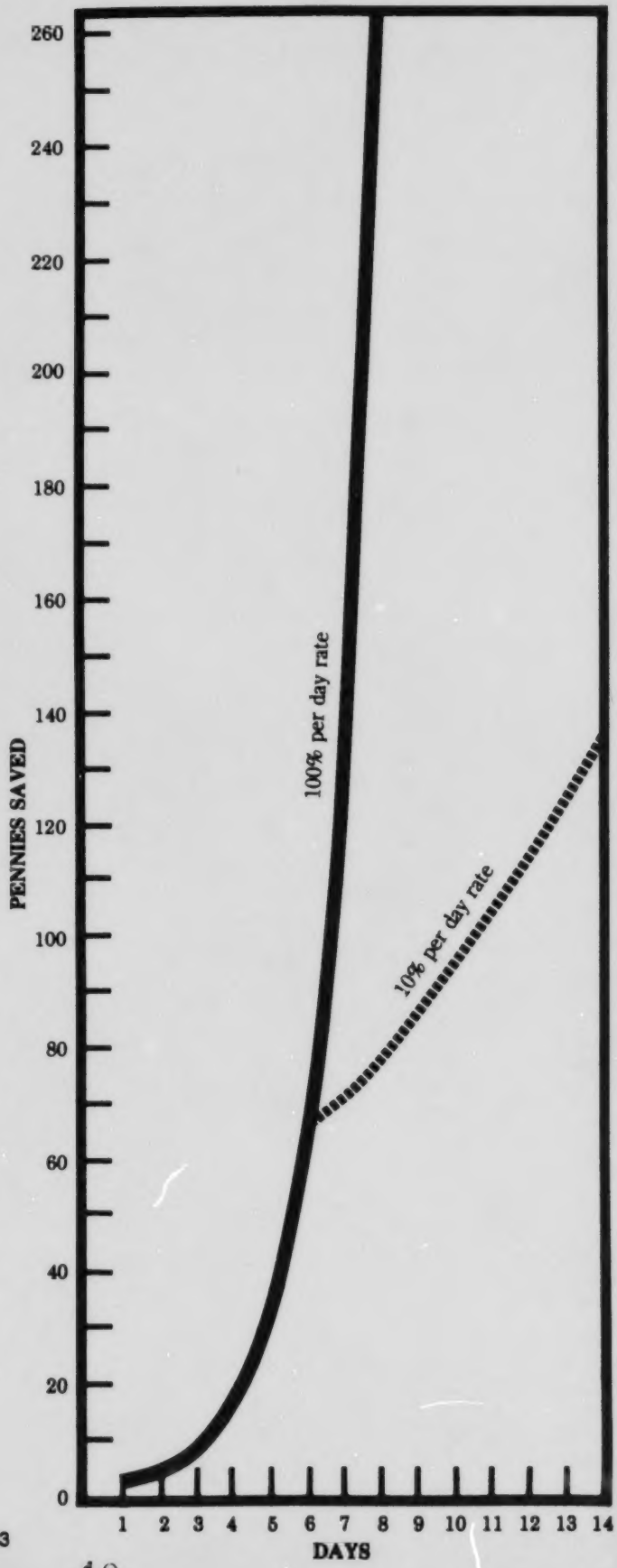
Areas where exponential growth has occurred can be found throughout history. However, exponential growth is very hard to maintain.

For example, during the early stages of the Great Transition the population growth rate was very rapid, producing a curve, or trend, similar to the one produced in the "100 percent savings program." But the world's population growth curve is now starting to flatten out, just as occurred when the 10 percent savings program was started. The chart below shows this flattening out from a *J-shape*. The curve is becoming an *S-shape* as the *rate* of growth slows down.

WORLD POPULATION GROWTH RATE DURING THE GREAT TRANSITION



Source: Kahn, H. *World Economic Development*, Morrow Quill, New York, 1979, p. 66.



The flattening curve looks similar to the dotted line curve in the pennies chart, when we stopped doubling our pennies on day 6 and only increased them by 10 percent each day. Both curves indicate that the ***total number*** of people (or pennies saved) is still growing, but not as rapidly as they once were.

Which of the following describe exponential change? Circle "yes" if the change during the period of time *is* exponential, "no" if the change *is not* exponential.

1. Between 1965 and 1980, the murder rate in the U.S. increased by 5% per year.

   YES or NO

2. Between 1965 and 1980, the murder rate in the U.S. doubled.

   YES or NO

3. Between 1979 and 1980, 63% more families went on food stamps in Arizona.

   YES or NO

4. If you put $100 in the bank at 7% annual interest, and if you have the interest added to your account as it accrues, in 10 years you will have $200, and in 20 years you will have $400.

   YES or NO

5. The population of the region grew at a steady 1% per year for 5 years, then grew at ½% per year.

   YES or NO

6. The population grew 5% per year for 5 years, then 6% for 5 years, then slowed to 5% again for 5 years.

   YES or NO

Technically, any increase which is governed by a constant exponent is considered "exponential." However, the term "exponential growth" as it has come to be used to describe some modern events (e.g., rapid population growth) has adopted a less technical meaning: any rapid and relatively constant increase in numbers. Any graph of such growth would show a steep inclining (or declining) curve. Thus, while questions #5 and #6 technically have exponents, the exponents are relatively small and the resulting growth is gradual, so the change is not "exponential" in the more popular use of the term.

We are attempting to teach students the meaning of "exponential" and "exponentiality" as it has been popularized by the limits to growth debate.

It is important to emphasize that exponential growth serves to alert us to any rapidly changing reality. Exponentiality prompts us to focus attention on a particular trend, while always remembering that (in both physical and social systems) true exponential growth rarely continues for very long.

(You might also refer students to the discussion on page 40 of the rapid growth in computer technology; namely, the vastly increased capacity of the computer to process information, which has grown exponentially. One of the most basic flaws in the "limits to growth" argument is that proponents cite the doubling of world population while failing to mention the doubling in technological productivity during the same period.)

ACTIVITY 8

TRENDS AND COUNTERVAILING FORCES

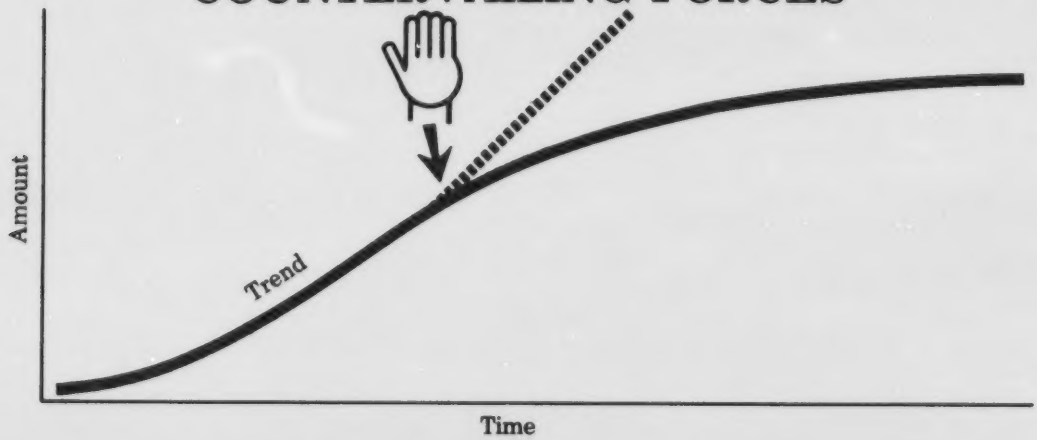
Trends, like a trend in population growth rate, can change for many reasons. Trends are often charted or graphed by scientists. This enables people to view a trend in visual form. For example, an "S-shaped" curve appears to bend over as if some force starts to push it down. This force is sometimes called a *countervailing force. A countervailing force occurs when a trend creates a force that opposes it.* Many macro-historians believe that the trend of increasing wealth in a civilization can be halted because increasing wealth can make a civilization careless and lazy, which can lead to a reduction in the factors that produced the increase in the first place.

Whenever we predict, we must consider not only recent trends (like population growth at high rates), but also the impact of countervailing forces, like decisions to limit family size. Very few trends can continue for long periods of time without generating opposing forces affecting their direction or rate. History shows many instances of societies like the Roman Empire that have grown in power and influence but then declined because of countervailing forces. Other societies then grow in strength, encounter other types of forces and, in turn, decline.

A more recent example of countervailing forces can be seen by studying U.S. gasoline prices. In the 1970's U.S. gasoline prices rose very sharply due to an oil embargo. Some people thought that these prices would continue to rise indefinitely, so companies bought huge quantities of gasoline and stored it for later sales. And, since oil producing countries were getting such high prices for their product, they produced and sold as much as they could. In response to all this, people could not afford as much gas as before, so they drove less and purchased less gasoline. All these actions created what many economists in the early 1980's called an oil "glut," and, in reaction to this glut (or over-supply of product) prices began to fall. In this case, economic conditions (and other political considerations) eventually created a countervailing force to the increasing price trend of gasoline. New technological developments can create a countervailing force too (like the development of a synthetic replacement for gasoline).

Reproduced on the next page are two letters that could appear in a newspaper. Each letter describes a trend that concerns the author (for example, the world's population is growing too fast or we are using too much gas and oil). Read each letter. Then write a one-page response to each letter that provides an alternative viewpoint. Your response should include a consideration of specific countervailing forces that could effect the trend described in that letter.

COUNTERVAILING FORCES



Letter 1:

Dear Editor:

Do you realize that the world's population is doubling every 35 years? This is a fact which we must face up to: the world is finite, and it presently holds over 4 billion people. At this rate of growth, how can the earth possibly hold 8 billion people 35 years from now?

The problem of world population growth is made worse by our technological progress. Since births now consistently outnumber deaths, our longer life expectancy is making us too populous for our own good.

Everyone already feels crowded. Look around you right now: can you imagine *twice* as many people as you now see, constantly milling around, competing for the same goods and services which you need to live your life well?

Well, that's what the world is going to be like if we don't do something soon about our out-of-control population growth!

Signed,

Feeling Crowded

Letter 2:

Dear Editor:

Apparently we have not learned a lesson from the oil and gas shortages of 1974–75. If we continue to consume oil at the rate we were in 1973 (which we seem to be doing), we have only 80 years left in which to use up the remaining oil, and 112 years to use up the natural gas. If our consumption of these nonrenewable resources increases, we have only 35 "years" of oil left, and 30 years of natural gas. What will the world do when it runs out of oil and gas? It stops running!

The only way to adequately address this alarming problem is for all of us to commit ourselves to drastically different life styles. We must stop consuming as much, since it takes energy both to create consummable goods and to consume them. We must restructure the world's economy by slowing down economic growth, and by re-distributing these scarce resources of oil and gas so that all nations will have enough to supply their basic needs, until we can figure out a way to supply our energy needs in the future. This will take pain and sacrifice, but it's the only way to avoid disaster.

Signed,

Out of Gas

(See next page for "appropiate" answers)

ACTIVITY 8 - TRENDS AND COUNTERVAILING FORCES

Letter 1 - "Feeling Crowded"

An appropiate answer could include:

- *The fact that doubling of total numbers is not as significant as the rate at which population growth is taking place.*
- *Knowledge itself has been a countervailing force to population growth: as people become aware of the growing world population, they have chosen voluntarily to limit their own family size.*
- *The "carrying capacity" of the earth is far greater than usually acknowledged. Thomas Sowell, a noted social scientist, recently calculated that all of the world's current population could be moved into the state of Texas, and each person would still have 1,700 square feet on which to live!*
- *The fact that total births outnumber total deaths is relatively unimportant. (The relation between birth and death rates in most countries of the world has gone through a "demographic transition," and the two rates now track each other rather closely.) The important statistic is the relation of birth to death rates in developing countries.*
- *Longer life expectancy is a good development. The longer we live, the fewer children we want to have, since caring for them becomes increasingly more expensive.*
- *The competition which occurs from having more people will itself help to slow down growth. (Social science research has shown that "crowding" is relative: Australians feel they are running out of land, while the Dutch do not feel so!)*

Letter 2 "Out of Gas"

An appropiate answer could include:

- *Past projections about when we are going to "run out of gas" have been consistently wrong.*
- *Knowledge of the problem of gasoline scarcity has itself helped to motivate people to use less.*
- *Supply and demand has caused people to use less gas, since it has become more expensive (see Unit III). Rising prices will slow consumption without our needing to change to "drastically different lifestyles."*
- *Slowing down economic growth will not solve the problem, it will only penalize the poorer countries which are farther down on the development "ladder."*

Activity 8 (cont.)

- *Restructuring the world's economy would be virtually impossible to accomplish. "World government" hasn't worked well.*
- *Before we legislate "pain and sacrifice" for the whole world, we should make sure our facts are right!*

Encourage students to argue the case in opposition to the "letters," even if they object to the author's point of view. Learning the opposition's argument helps to strengthen one's own point of view.

ACTIVITY 9

WORLD ECONOMIC INTERDEPENDENCE: EXPORTS AND IMPORTS

Read the two brief sections and one article that follow. Then, fill out the charts at the end of this activity.

U.S. Exports and Employment

U.S. exports create a lot of jobs in the United States. The employment generated by exports is much greater than just the workers producing the final products that are exported. Exports create a large demand for employment that spreads throughout the U.S. economy. These jobs include all the indirect employment needed to produce goods and services supplied to export producers, the employment directly needed by the export producers to produce exports, the employment directly and indirectly needed to move products to ports of exportation, and employment related to the international banking end of an export transaction.

- In 1982 over 5 million workers owed their jobs to U.S. exports.*
- Employment generated by total exports is mainly in manufacturing and services. In 1980, 49 percent of export related jobs were in manufacturing and 37 percent in services.*
- The importance of export employment to individual industry groups varies widely. In 1982, export-related employment accounted for:*
  — 1 in 8 jobs in manufacturing
  — 1 in 30 jobs in services.

The U.S. exports many items. These include food, agricultural machinery and related products, engineering products (e.g., aircraft, computer parts), medical products (e.g., drugs, machinery) and even information. So, many workers in the U.S. depend on exporting for their jobs, and many people in other countries depend on the U.S. for the things that we export to them.

Imports and World Trade

How many objects can you find in your home that were made in foreign countries? Certainly, you know that many of the things that people in the U.S. buy were sent to us by other nations. Cars, foods, clothing, and electronic equipment are just some of the many things that the U.S. buys from other countries.

Some of the countries that we import from are "rich" countries (e.g., Japan, West Germany), others are relatively poor countries (e.g., Nigeria, China). In each case, U.S. dollars that purchase products made in foreign countries help their economy grow. And, when we export our products to these countries, they help our economy, too.

*Source: Lester A. Davis, "Domestic Employment Generated by U.S. Exports," Office of Trade and Investment Analysis, International Trade Administration, U.S. Department of Commerce (May, 1983), Executive Summary (Data corrected to be consistent with the body of the report.)

For U.S., an Age of Reliance on Other Nations

The struggle for economic strength can only grow more intense. America's strong suit: Brainpower.

Like it or not, the U.S. is destined to become more and more dependent on other countries for the goods and services it needs.

For all nations, competition for a share of the world economy will be brisk because expansion of trade is expected to slow from the heady growth that took place in the 1960s and 1970s.

Trade wars and protectionism will increase as governments try to keep jobs from being lost to foreign competition, and international monetary authorities will be hard pressed from time to time to accommodate developing countries suffering debt problems.

Increasingly, the U.S. will move from a nation that not long ago was almost totally self-sufficient to one heavily reliant on other countries for many of its needs and wants. Washington trade attorney Bart Fisher predicts that U.S. trade with other nations will equal 40 percent of the gross national product by the year 2000—up from about 20 percent now. In 1950, foreign trade was just 2 percent of GNP.

The U.S. also will join hands with trading partners in all sorts of joint ventures. There is growing talk among multinational corporations of a "world car," parts of which would be assembled in different countries.

But don't look for the birth of new and powerful cartels, such as the Organization of Petroleum Exporting Countries. Experts note that OPEC's current troubles show that world markets eventually undermine a system based on artificially high prices.

Still, just as OPEC called the shots in the world economy through much of the last decade, other powers will emerge and claim markets that were once the province of established countries. For a closer look at the trade forecast for the next half-century—

U.S. and Canada

The U.S. will depend on its technical know-how and vast resources—rather than heavy industries. Large shares of the auto, steel and textile industries will be lost to developing nations, but the U.S. will remain a big seller of coal and grain.

Says economist Jimmy Wheeler of the Hudson Institute: "We will continue to be one of the most productive agriculture suppliers in the world."

The U.S. also will grab big shares of world exports of engineering products, aircraft, laser technology, telecommunications equipment, medicine, scientific instruments and engines.

"I see us and the Japanese as leaders of supertechnology products," says economist Gerard Adams of the Wharton School of the University of Pennsylvania. "That includes biotechnology, bioengineering, computer software and integrated circuits."

Rapid expansion will come, too, in trade of banking, insurance and other services, according to C. Fred Bergsten, director of the Institute for International Economics in Washington, D.C.

This country's northern neighbor is likely to come out ahead, too, because of its agricultural potential and its enormous supply of raw materials and energy sources. Forecaster Marvin Cetron of Arlington, Va., predicts that in 20 years Canada will be one of the three most prosperous nations in the world, along with the U.S. and Australia.

Western Europe

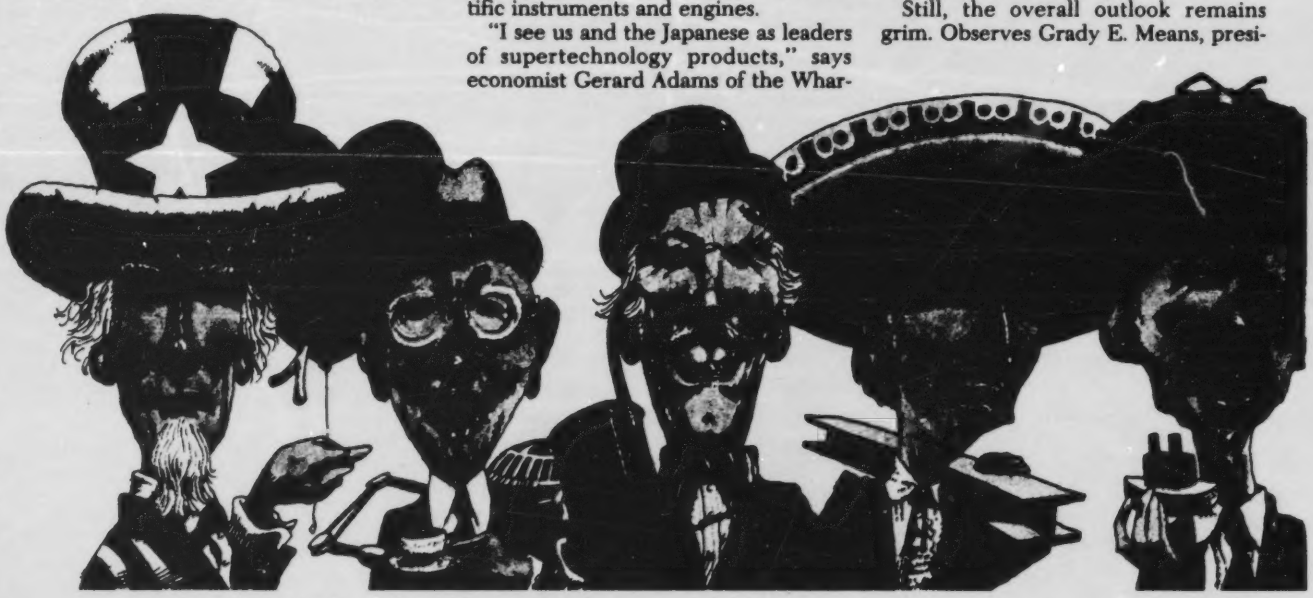
Tough times are in store for the region that dominated world commerce for centuries.

"The problem European countries will have is in horribly sick steel and auto industries," says attorney Fisher. "They won't be able to compete on wage scales with Far Eastern countries." Even in service fields, Europe is at least 10 years behind the U.S. and will have trouble catching up, he predicts.

One ray of hope for the European Economic Community is its growing aircraft industry. In addition, France and West Germany are likely to become major exporters of equipment and technology for nuclear power plants early in the next century.

In the years ahead, Britain will depend on oil, gas and financial services. Spain and Italy have some prospects in shoes and agriculture but may suffer from political instability.

Still, the overall outlook remains grim. Observes Grady E. Means, presi-



A28 Copyright © 1983, U.S.News & World Report, Inc.

dent of SAGE Associates, Inc., a Washington, D.C., management-consulting firm: "Economically and politically, Western Europe is very bleak."

The Soviet Bloc

If Europe falters, the Soviet Union won't be taking its place. Russia's strength is in its rich natural resources —not its manufacturing.

The U.S.S.R. will be selling energy to the West, particularly natural gas when the Siberian gas pipeline is completed. It also will increase sales of its huge reserves of gold and timber.

Because of their mounting debts, the Soviets may dump such commodities on world markets at low prices, says Mikhail Bernstam, East-West trade specialist at the Hoover Institution in Palo Alto, Calif.

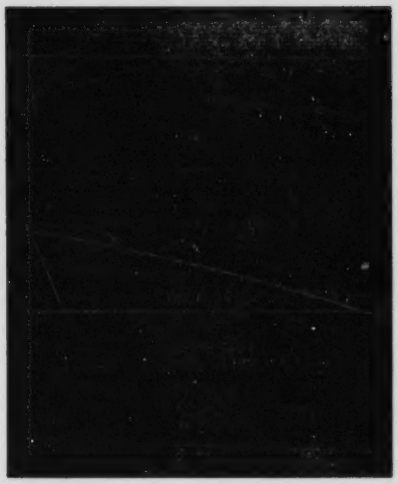
Others see little economic progress among Eastern European countries except for Yugoslavia and Hungary, both of which will gain stature as producers of textiles and related goods.

The Far East

The brightest outlook in the next half-century's trade picture is in East Asia. "Japan will continue to grow more rapidly than the rest of the industrial countries through the 1980s and beyond," says Wheeler of the Hudson Institute.

Many see Japan as a highly urbanized information-processing community, prominent in banking, biogenetics, computer technology and other electronics industries.

But Japan may well lose its steel and auto industries to other countries in the region. "Taiwan, Hong Kong, Singapore and South Korea are at about the same stage of transformation that Japan



was in the late 1960s and 1970s," says Ramon Myers, senior fellow at the Hoover Institution.

He predicts that these four economic upstarts will improve steadily in such fields as textiles, machine tools, chemical products, metals and electronics.

Moving in to take their places may be the Philippines, Thailand, Indonesia and Malaysia.

If they can feed their growing populations and their governments are stable, there is no reason these countries couldn't become producers of steel and textiles over the next 50 years. Similarly, India, with its teeming millions, could play a bigger role in low-skill manufacturing.

China, already battling for a larger share of the textile business in the United States, is another growing economic power. Experts say the Chinese have good business sense and are able to maintain low wage rates. Their supplies of oil, gas and coal and their agricultural potential also are coveted by foreign businesses.

Perhaps still bigger opportunities await Australia, with its large reserves of coal, oil, natural gas, iron, bauxite and uranium. The land down under will continue to boast one of the highest living standards in the world.

Mideast and Africa

Oil will be the driving force in the Mideast. A few industries based on petroleum, such as chemicals and plastics, may develop, but the region is given little chance of building an extensive manufacturing base.

Nor do economists see much chance of OPEC becoming a powerful force again. Reason: Industrialized nations will move increasingly toward development of alternative sources of energy.

For most of Africa, economists and international experts find little potential. "It's hard to see the Africans really catching up enough to be important participants," says economist Bergsten. "Most are still traditionally commodity exporters and will remain the same."

Unstable governments, socialist economies and poor roads and equipment will discourage business investment, in the view of Ian Butterfield, Africa specialist at the Heritage Foundation in Washington, D.C. South Africa's biggest industry may be arms exports to nations that cannot get them from the major powers.

Latin America

Mexico, Brazil and Argentina are expected to take advantage of natural resources and overcome their huge debt burdens to become leading economic powers over the next 50 years.

Economist Adams says Mexico could become a major steel producer: "They can ship in the iron ore from Venezuela and make steel on very favorable terms and sell it cheap on the world market."

Others predict that Brazil will be a leading auto maker, selling many cars to its own consumers in the next century. Meanwhile, Colombia, Peru and Chile will increase their shares of exports of textiles, shoes and similar goods.

Even with bankers banging on their doors today, countries in Latin America—and Asia as well—have great potential to become healthy exporters. "What it really takes is economic management," says Bergsten. "As we've seen in the last 20 years, many of these nations can, when properly run, be quite successful." □

RICHARD ANDERSON FOR USN&WR

BEST COPY AVAILABLE

Identifying Imports and Exports

How many things can you find around your house that were made in a foreign country?

CATEGORY	ITEM	MADE IN
1. Clothes	Shirt or Blouse	Hong Kong
2. *Entertainment*	*Stereo*	*Japan*
3. *Transportation*	*Car*	*(Country will vary depending*
4. *Household goods*	*Rug*	*on category and item*
5. *Household goods*	*Furniture*	*student chooses)*
6. *Toys*	*Video Game*	"
7. *Appliances*	*Microwave*	"
8. *Luggage*	*Suitcase*	"
9. *Shoes*	*Sandals*	"
10. *Entertainment*	*T.V.*	"

What specific things do these countries import from and export to other nations? You will need to do some library work to find the answers.

COUNTRY	MAJOR EXPORTS	MAJOR IMPORTS
MEXICO	*petroleum, copper, lead, zinc, sulphur, coffee, shrimp, sugar*	*automobiles, machinery, industrial equipment, iron, steel*
GREAT BRITAIN	*autos, chemical products, machinery, ships, textiles*	*food stuffs, oil, raw materials*
CHINA	*textiles, tea, fruits, grain, pork, vegetables, petroleum*	*metals, machinery, food stuffs, fertilizers, iron, steel, tin*
ITALY	*machinery, metal goods, chemical products, autos, textiles, shoes*	*oil, oil products, metal scrap, ores, textile fibers*
INDIA	*manuf. goods (textiles), metals, metal products, tea*	*indust. supplies, fuels, food stuffs, machinery, fertilizers, raw cotton*
SAUDI ARABIA	*petroleum, shrimp, fertilizers*	*food prod., machinery, military equip., transportation equip.*
MALAYSIA	*rubber, tin, palm oil, petroleum, timber*	*chemicals, machinery, manuf. goods, food*

**NOTE: Encourage students to find several distinct categories, rather than focusing on only one category, e.g., clothes.*

ACTIVITY 10
CHANGE AGENTS: TECHNOLOGY

Technological change *is* exciting. To get a perspective on this change, interview people who are 25 and 50 years older than you are. Speak to your parents, grandparents, neighbors and teachers. Ask them what have been the biggest technological changes since they were in high school. Then, think about the future and make some guesses about technological change that could take place during the next 25 years and fill in this chart. "Long Distance Communications" has been filled in as an example. If you need more information, consult a general encyclopedia or other reference books which deal with technological change.

AVAILABLE TECHNOLOGY

	50 Years Ago	25 Years Ago	Today	25 Years From Now
Long Distance Communication	Mostly letters	Expensive phone calls transmitted over wires only	Low-cost calls often transmitted by satellite or microwave	Laser and fiber optic transmission; use of computers for teleconferencing; video-phones
Transportation	*Cars, few & slow* *Steam engine.* *Railroad.*	*Early jet planes* *Many cars.* *Primitive rockets.*	*Space shuttle.* *SST.* *High-speed trains* *Air travel worldwide.*	*Personal helicopters.* *Pollution-free cars.* *SST's common.* *Space travel.* *1300 MPH trains.*
Data Processing	*Hand calculations.* *Primitive machines*	*Early computers.* *Calculators.*	*High-speed computers.* *PC's and Micros.* *Telecommunication.*	*Satellite use common.* *Faster computers.* *Speech processors.*
Television	*First TV transmission. (1926)*	*B/W TV.* *Color TV just invented, poor reception, few channels.*	*Cable TV, VCRs.* *Satellite dish.* *2-way TV,*	*Shopping, banking, voting, newspapers by TV.*
Medical Technology for Heart Diseases	*Kills 14% of Americans* *#1 killer* *High blood pressure discov. as cause.*	*1st successful open-heart surgery.*	*Heart bypass.* *Transplants.*	*Synthetic oils eliminate cholesterol.* *Computer chip pacemakers.*
Automobiles	*Model T replaces Model A.*	*Power steering and brakes* *50,000,000 cars.* *Radial tires.*	*Electric cars.* *"Talking cars".*	*Cars fully computerized.* *Pollution-free cars.*
Recorded Music	*Gramaphone "horn" replaced by electricity.*	*Stereos common.* *Cassette invented.*	*Video & audio discs.* *Computerized music. "Walkmans".*	*Laser discs.* *Recording studios mobile & portable.*
Medicine for Infections	*Malaria, tetanus & smallpox cured.* *Penicillin discv.*	*Non-penicillin antibiotics.* *Resistant bacteria develp.*	*Anti-rejection vaccines for transplants.* *Interferon discv.*	*Cancer source discovered.* *Common cold cured.*

UNIT TEST BANK

THE GREAT TRANSITION

15. Looking at history over long periods of time is called _____. *(macro-history)*

16. The period of 400 years, from a past when people were few and poor to a future in which they will be numerous and rich, is called _____. *(The Great Transition)*

17. One characteristic of the Great Transition is _____ _____. *(increased control over nature)*

18. Another characteristic of the Great Transition is _____ _____. *(changes in population growth)*

19. A third characteristic of the Great Transition is _____ _____. *(increased wealth)*

20. The stage of the Great Transition in which 90% of the population work in agriculture, hunting, fishing, or mining is called _____. *(a)*
(a) pre-industrial (b) third-world (c) backward (d) primitive

21. Hunting, fishing, and mining are considered to be _____ activities. *(primary)*

22. Once fewer people are needed to produce food, and population increases rapidly, societies usually have entered the _____ stage. *(industrial)*

23. A society in which most of the population provides services rather than goods is the _____ stage. *(d)*
(a) agricultural (b) industrial (c) pre-industrial (d) post-industrial

24. Population grows slowly in pre-industrial societies because of . . . *(d)*
(a) disease (b) starvation (c) natural disasters (d) a, b and c

25. Which of the following are true of pre-industrial societies: *(d)*
(a) population is basically rural (b) most work is done in order to secure basic needs (c) the population grows slowly (d) a, b and c

26. According to Thomas Malthus, the growth of world population will . . . *(b)*
(a) create exciting new opportunities (b) lead to mass starvation (c) increase wealth (d) create a new social order

27. According to Thomas Malthus, the population will eventually reverse itself because . . . *(d)*
(a) of birth controls (b) there will be a war (c) disease will wipe out many people (d) b and c

28. As societies become industrialized, the size of families _____ . *(decreases)*

29. A major reason that families in industrialized societies limit their size is . . . *(d)*
(a) there is less need for their children's labor (b) more women enter the work force (c) children become expensive to support (d) a, b and c

30. Industrialization is sometimes called . . . *(a)*
(a) modernization (b) countervailing (c) agronomy (d) institutionalization

31. Instead of being producers of wealth, children in industrial and post-industrial societies tend to become _____ of wealth. *(consumers)*

32. The largest surge in manufacturing in the U.S. during its industrial stage was during _____ . *(the Civil War)*

33. Since 1800, the U.S. birth rate has been . . . *(c)*
(a) steady (b) increasing (c) decreasing (d) countervailing

34. Cities grow during industrialization because fewer people are needed to . . . *(b)*
(a) provide services (b) produce food (c) manufacture goods (d) none of these

35. As wealth increases, the focus of people's attention shifts from "needs" to "_____". *(wants)*

36. The average income earned by the population of a country is called the _____ income. *(per-capita)*

37. When President Kennedy used the phrase "a rising tide lifts all ships," he meant . . . *(d)*
(a) when the rich get richer, the poor get poorer
(b) rich people should contribute to charities
(c) rich countries get richer by exploiting poor countries
(d) as the world develops economically, all countries should get richer

38. In general, greatest economic growth has occurred in the countries that are considered . . . *(c)*
(a) wealthy (b) poor (c) middle-income (d) democratic

39. Because many wealthy countries exist, industrialization in poor countries now progresses at a . . . *(b)*
(a) slow rate (b) fast rate (c) same rate (d) none of these

40. Manufacturing and construction are considered to be which of the following type of economic activities? *(b)*
(a) primary (b) secondary (c) tertiary (d) quaternary

41. "Tertiary" jobs involve supplying _____ rather than manufacturing goods. *(services)*

42. When a society can produce more goods than it needs, it begins to enter the _____ stage of civilization. *(super-industrial or post-industrial)*

43. One important aspect of super-industrial societies is the _____ of projects. *(d)*
(a) validity (b) politics (c) slowness (d) scale

44. Another important aspect of super-industrial societies is... *(a)*
(a) the speed with which change occurs (b) the increase in population (c) the primary nature of projects (d) the concept of "middle income"

45. The period of the Great Transition is best portrayed as a _____ in the overall population growth rate picture. *(spike)*

46. During the super-industrial stage, information and knowledge become . . . *(c)*
(a) forbidden (b) uncertain (c) a commodity (d) unreliable

47. Why are there no exact dates for the Great Transition? *(b)*
(a) History is not an exact science.
(b) It is a concept.
(c) Important records were lost.
(d) It is a matter of controversy.

48. In the 21st century world population growth rate will . . . *(a)*
(a) continue to slow (b) continue to increase (c) decrease, then increase sharply (d) increase, then decrease sharply

49. In the future, which of the following areas of medicine will grow in importance . . . *(c)*
(a) pediatrics--care of children
(b) group practice
(c) geriatrics--care of the elderly
(d) family medicine

50. U.S. birth rates and death rates have both _____ since the 19th century. *(a)*
(a) fallen (b) risen (c) remained steady (d) they have moved in opposite directions

51. Compared to 1983, the U.S. population in 50 years will be . . . *(b)*
(a) smaller (b) larger (c) about the same (d) younger overall

52. What does the phrase, "being rich is a relative term," mean? *(c)*
(a) How much money you have depends on how rich your parents were.
(b) Most people never get richer than their parents.
(c) What is "poor" for one person may be rich for another.
(d) You are rich only if your lifestyle allows you to afford your "wants".

53. During post-industrialization, nations should grow . . . *(c)*
(a) more hostile (b) more independent (c) more interdependent (d) less Communistic

54. As developing countries become richer, they will . . . *(d)*
(a) grow more democratic (b) be fairer to the people (c) grow more educated (d) a, b and c are uncertain

55. One of the great byproducts of the scientific method and of invention is . . . *(a)*
(a) they lead to the creation of other inventions
(b) they make people more curious
(c) they decrease the growth of population
(d) they make countries wealthier

56. Gross National Product (GNP) means . . . *(c)*
(a) the average amount of money earned by each person in a nation
(b) the average number of products produced by a nation each year
(c) the total estimated value of all goods and services produced in a nation during a particular time period
(d) the total estimated value of all goods produced in a nation during a particular time period

57. ENIAC filled a room as big as a house and was the first modern _____. *(computer)*

58. Information expressed in terms of only 2 numbers ("0" and "1") is called _____. *(binary)*

59. Vacuum tubes in computers were eventually replaced by _____, which were developed by Bell Labs. *(transistors)*

60. Another word for the microprocessor, the building block of modern computer technology, is the _____ chip. *(silicon)*

61. The "spinoffs" NASA officials talk about refer to . . . *(c)*
(a) future space flights
(b) planets that will be discoverd in the future
(c) alternative uses for space technology
(d) shuttle trips to space stations

62. An example of a space spinoff is . . . *(d)*
(a) medical diagnostics (b) firefighting methods (c) ways to improve sewers (d) a, b and c

63. Robots are currently used extensively in the manufacture of . . . *(a)*
(a) cars (b) artificial organs (c) microcomputers (d) lasers

64. Miniature lasers built into micro-chips is the basis for a new communication system called . . . *(a)*
(a) photonics (b) cataracts (c) binary code (d) none of these

65. "Gene splicing" will enable scientists to . . . *(d)*
(a) produce new forms of bacteria
(b) find new ways to produce insulin
(c) find new ways to produce vaccines
(d) all of the above

ACTIVITIES: RESOURCES FOR THE FUTURE

ACTIVITY 11

WHAT IS A RESOURCE?

PART I

You read in your text that a resource includes not only *raw materials* but also three other components. List the three other parts below:

1. Raw Materials
2. *Technology*
3. *Society*
4. *Supply and Demand*

PART II

Now consider each of the materials listed below. Can you explain how each becomes a resource? For example, the material *uranium* is a resource because, (a) we can extract it from the ground (raw material), (b) we have a technology available that allows us to convert it into power in the form of nuclear energy (technology), (c) we have transportation systems to move it from the mine to where it is needed, colleges to teach people engineering and metallurgy, capital to invest in uranium-related research projects, and other societal skills (society), and (d) it is the best or cheapest way of accomplishing a certain purpose — nuclear power generation — so there is a demand for it (supply and demand). What about these others? (If you do not know how each is extracted, used, or transported, consult the *McGraw Hill Encyclopedia of Science and Technology, Encyclopedia Americana,* or *World Book.*)

Explain how each of the following become resources:

COPPER:

a. How is the raw material made available?

The copper ore is mined, either through "open-pit" mining (low percent of copper in ore) or underground mining (higher percent of copper in ore).

b. What technology is used to extract, refine and use the raw material?

The copper is removed in 3 stages: 1) ore dressing; 2) smelting or electrolysis to remove copper from ore; and 3) refining of copper. It is then shaped for many purposes.

c. What institutions, organizations and people skills help convert the raw material into a useful form?

Mining companies sell to factories which make copper products. Shippers move products around the world. Merchants sell and trade copper. Industry uses copper for many products and processes.

d. What products or uses does the material have? (Why is there a demand for it?)

Copper is used in pipes and for utensils. It is a good conductor of electricity. Jewelry and coins are made of copper.

WATER:

a. How is the raw material made available?

Water is pumped from aquifers or diverted from rivers into pipe systems for use, or into storage.

b. What technology is used to extract, refine and use the raw material?

Pumping technology has existed for a long time. Water is now filtered and purified for use (and re-use). Sterilization is now required, usually by means of chlorination.

c. What institutions, organizations, and people skills help convert the raw material into a useful form?

Water supply systems are essential to civilization. Cities supply citizens water, or water companies supply water in the absence of government. (The CAP is an example of a "macro-organization.")

d. What products or uses does the material have? (Why is there a demand for it?)

Water is and always will be essential for life. Demand fluctuates seasonally, and varies between industrial and residential use.

ASBESTOS:

a. How is the raw material made available?

It occurs in fibrous form in rocks. It is mined or quarried, the rock is crushed and asbestos is removed by blowing.

b. What technology is used to extract, refine and use the raw material?

In addition to the mining process, asbestos is spun into yarn by spinning with cotton, or used in paper or as cement. It is used as a fabric for flame retardation, and is resistant to chemicals as well.

c. What institutions, organizations, and people skills help convert the raw material into a useful form?

Factories manufacture products out of asbestos to resist flames. Shipbuilders line ships with it. Commerce and trade get products to people.

d. What products or uses does the material have? (Why is there a demand for it?)

Despite its historical use for nonflammability, the discovery of its carcinogenic effects has seriously reduced the demand for it. It is still used in controlled circumstances.

OIL:

a. How is the raw material made available?

Oil must first be discovered, then a well must be drilled. It must then be refined into usable forms, and transported to users and markets.

b. What technology is used to extract, refine and use the raw material?

Oil drilling technology, sophisticated scientific methods of exploring for new reserves, various chemical refinning processes, conversion technologies, and off-shore oil rigs.

c. What institutions, organizations, and people skills help convert the raw material into a useful form?

Oil requires vast amounts of capital and organization to discover, recover, refine, convert and transport it. Oil companies are the world's largest corporations. Vast oil transportation networks are needed.

d. What products or uses does the material have? (Why is there a demand for it?)

Petroleum provides ½ the energy used in the world. It powers car, plane, and ship engines and heats homes. It is a common ingredient in many other products.

TITANIUM:

a. How is the raw material made available?

Rutile in ocean sands and ilmenite (found underground) are scooped up processed to yield titanium. Various chemical processes refine the mineral to usable form.

b. What technology is used to extract, refine and use the raw material?

Several steps are required, involving chemical processes to eliminate oxygen and nitrogen. The mineral passes through several liquid forms before being processed as ingots. Alloys are mixed with titanium to maximize its tensile strength.

c. What institutions, organizations, and people skills help convert the raw material into a useful form?

Titanium mining occurs in several countries. Because of processing requirements, the organization of a large corporation is needed to make it marketable.

d. What products or uses does the material have? (Why is there a demand for it?)

Titanium is a space-age mineral. It is used in jet engines and in the structures of jet planes and space vehicles. It is also used in chemical processing equipment which needs to be corrosion-resistant.

COAL:

a. How is the raw material made available?

Coal is mined from cavities deep in the ground, as well as processed from ore found near the earth's surface ("strip mining"). It is processed and burned as fuel.

b. What technology is used to extract, refine and use the raw material?

Large machinery is used to extract and crush coal. New technologies transport coal as "slurry" in pipelines.

c. What institutions, organizations, and people skills help convert the raw material into a useful form?

Coal is a widely-used fuel for industry worldwide. It is transported to power plants where it generates electricity in boilers. Coal is traded and shipped worldwide.

d. What products or uses does the material have? (Why is there a demand for it?)

Coal has been in demand since the dawn of the Industrial Age. It remains a key source of electrical generation, though it burns impurely, causing air pollution ("acid rain"). It is much less in demand as a source of direct residential heating.

ACTIVITY 12

SOLVING RESOURCE PROBLEMS

Read the scenario that follows and then answer the questions on the next page. Keep in mind that while this scenario was written about copper, it could apply to other raw materials as well.

A SCENARIO ABOUT COPPER SHORTAGES

January 1985 After American copper resources are depleted in the late 1970s or early 1980s, and the demand for copper doubles, the price of copper rises from $1 per pound in 1984 to $10 per pound in May, 1985.

May 1985 As the value of scrap copper, most of which is easily salvageable, increases from 70 cents to $9 per pound, metal dealers realize that existing United States copper supplies above the ground amount to almost 90 million tons. This, if salvaged, would be worth $1.7 trillion. A rush develops to locate old brass beds, brass handles, copper pots, lamps, locks, and all other copper scrap. Sixty-five billion pennies, now worth 5 cents apiece, are turned in to scrap dealers.

July 1985 Utility companies go into a crash program to substitute aluminum for copper in transmission lines, engineers begin designing copperless heat exchangers, many radiant-heated floors and walls are ripped open to get the copper tubing [for scrap], and plumbers are in great demand to replace copper pipes and tubing in homes and buildings.

August 1985 CBS News reports one engineer's calculation that copper could be profitably extracted from many of the above-average grades of igneous rock at a cost of about $4 per pound. At a $6-per-pound profit from the copper, the higher-grade volcanic rock in the United States is now worth about $5 a ton (net profit) and the engineer estimates that there is more than $1,000-trillion worth of this rock within 100 feet of the surface. The next morning there is a stampede at every mining claims office in the world.

September 1985 People line up with barrels full of copper artifacts at every scrap yard in the developed world, waiting for their turn to sell.

October 1985 A major retooling has been accomplished; nearly everything that used to be made out of copper has been redesigned to use other metals. Where used at all, copper is applied in only very thin films, as in electroplating.

November 1985 Quotations on copper futures [in commodity markets] plummet, and they continue to crash during the next 38 days. By the end of the year copper is once again $1 per pound, and a month later it is only 50 cents a pound. Some of the new alternatives are found to have unanticipated advantages over the original copper construction, many substitute projects are already under way, and manufacturers are loath to risk using copper again.

December 1985 The copper affair sends shock waves throughout the world's economies; some organizations go bankrupt, and many people who had bought copper futures at $8 to $10 a pound are completely ruined.

What the Scenario Signifies

A number of conclusions can be drawn from this scenario:

1. Copper is a [recoverable] resource. Mining and smelting just change it from a low-grade ore below the ground to a very high-grade ore above.
2. The aboveground reserve is scattered but easily collectible—when the price is right.
3. There will be about 90 million tons of copper in the United States—aboveground.
4. At about $4 a pound the amount of copper available from ores becomes essentially unlimited.
5. Nothing made in quantity from copper today is critical. The electrical and heat-conduction properties of copper are excellent, but substitutes are available and some may even be cheaper once the capital is invested.
6. The price of copper will be limited in the long-term future by the cost of mining it from lower-grade ores or extracting it from marine sources. Either source will be much less than $4 a pound throughout the next century.

From "Good News From Mr. Bad News," by Edward Jay Epstein, *New York*, August 9, 1976. Reprinted by permission of Mr. Epstein.

A. We fear both scarce resources and increasing resource costs. But historically many events have contributed to making resources less scarce and less expensive. List three things that can be done if a raw material does become scarce.

Example 1. Conservation

2. *Substitution*

3. *New Technologies*

B. You have just listed three ways to counteract the effects of scarcity. Explain each in the space provided and then provide an example for each resource listed. (Examples for copper are already filled in.)

	COPPER	WATER	PETROLEUM
Conservation means: *Using less of the scarce resource*	Make thinner wire.	•*Special faucets and shower heads* •*New toilets* •*Not serving water in restaurants*	•*Car pooling* •*Driving less for leisure time activities* •*Setting thermostat lower in winter* •*Allocation (rationing) of gasoline*
Substitution means: *Finding some material to replace the scarce material.*	Use glass fibers instead of copper.	*(Note: some resources are essential, and total subsitution will be impossible)*	•*Train travel* •*Wood stoves* •*Nuclear power* •*Bicycling instead of driving*
Employing a new technology means: *Finding other and better ways of doing what the scarce material was used for.*	Use microwaves or other "wireless" communications.	•*Converting sea water for drinking* •*Ways of reducing evaporation* •*Drip irrigation*	•*Gasohol* •*Getting better mileage from a new engine* •*Building smaller cars* •*Battery-powered cars*

C. Now, think about the resource problems listed below. What *specific* events could occur that would be likely to solve each problem (e.g., develop a synthetic replacement for gasoline)? Write your answer in the space provided. (You might want to do some reading in reference books or consult your text.)

INCREASING COST OF GASOLINE:

- *Car manufacturers could develop an all-electric car.*
- *Better mileage and smaller cars could reduce the cost. (This is part of what is causing a current "oil glut" in the world.)*
- *New techniques may be discovered for refining gas more cheaply.*
- *Synthetic replacement.*
- *New oil deposits found.*

DECREASING GROUND WATER RESERVES:

- *Cost-effective ways of desalinating sea water.*
- *Recycling of effluent could supply non-human water requirements.*
- *Drip irrigation could be mandated for all farming done in desert areas.*
- *Cities begin to price water at marginal costs.*

DECREASING AMOUNTS OF PETROLEUM STILL IN THE EARTH:

- *Technologies for extracting oil from shale are perfected.*
- *Coal and nuclear replace oil for generating electricity in power plants.*
- *As oil becomes scarce, more exotic ways of searching and drilling for it (and re-using it) will become cost effective (see next activity).*

INCREASING PRICE OF ELECTRICITY:

- *Home owners begin generating their own electricity. (Cogeneration)*
- *Geothermal generation becomes profitable.*
- *Americans convert their kitchens to natural gas appliances and use woodstoves for heating.*
- *Americans use less electricity.*
- *More home solar use (and other "alternative" sources).*

DECREASING FARM ACREAGE:

- *Existing farm acreage is used to maximum productive levels.*
- *Hydroponics become economically viable.*
- *U.S. signs formal agreement with Mexico: crops (U.S.) for oil (Mexico).*
- *Cities enact "greenbelt ordinances," mandating that some peripheral acreage be kept in farming. (Cannot be sold or used for any other purpose, e.g., Marin County, California.)*

BEST COPY AVAILABLE

ACTIVITY 13

RESOURCE COSTS AND SUPPLIES

The article that follows is an excellent explanation of how various factors related to oil resources affect costs and supplies. Read the article and underline each of these factors. Be prepared to discuss each factor in class.

Oil glut was predicted by researcher in '79; supply fooled others

By Betty Beard
Republic Staff

In 1979, when most oil-consumption forecasts were predicting continued rising oil prices, leading many businesses into a mad scramble for energy investments, Dr. Bruce C. Netschert was predicting the opposite.

Netschert, a vice president with the National Economic Research Associates in Washington, D.C., correctly forecast the oversupply of oil that has flooded the world for the past year.

In a recent telephone interview, he explained why so many were wrong. He said they underestimated the supply of oil and overestimated the demand.

"They apparently were either unaware or did not appreciate the geologic information," explained Netschert, who has a degree in geology and a doctorate in economics.

"Also between 1974 and 1979, there wasn't much conservation and there wasn't much of an increase in the supply of oil. Once the gas lines (caused by the 1973 Arab oil embargo) were off, people got back into their big cars. People were fooled into thinking there never would be a conservation affect.

"They confused the short run with the long run," he said. "It takes time for these things to happen, about five years."

Netschert said that oil prices rose rapidly after 1973 but that it took about five years for conservation efforts to fully take effect.

Oil prices fell and then soared again in 1979, reaching their peak in early 1980 and prompting increased drilling. But by that time, continuing conservation efforts resulted in an oversupply.

Exxon was one oil company that paid heavily for projections of continued high oil prices. The firm invested more than $900 million in a shale-oil project near Parachute Creek, Colo., expecting the expensive-to-mine source of oil to become competitive at a time of rising oil prices.

The company stopped the project in May because of the stabilized price of oil and high costs of construction and money. Exxon has no current plans to revive the project.

"It was our guess that the time was extended considerably as to when it would become viable," said DI Bolding, the firm's regional public-information officer in Los Angeles.

Another thing the firm did was to quit making its oil projections public.

Bolding said, "We didn't find them to be accurate enough to keep messing with ... Our forecasts used to be virtually accurate, but in the last two or three years (before 1980), they got so bad our directors said this is enough embarrassment. That's enough of these slip-stick-type projections.

"We're still making projections. We just quit making them public," he said.

What does the man who guessed right have to say about the future?

There probably won't be any rapid oil- and gasoline-price increases such as the nation saw in 1973 and 1979, Netschert said. He agrees with oil companies such as Exxon and Chevron and other forecasters that the country will continue to moderate its use of oil between now and the year 2000, that oil-price increases will hover around the level of inflation and that this will move back the time at which synthetic and alternate energies will become economical.

Chevron, in a recent annual forecast, predicted total energy consumption to grow at a rate of only 1.3 percent a year through the year 2000 because of continuing conservation efforts.

Netschert said the exact rate will depend on the speed with which the economy recovers.

"I tend to think it will be rather slow here and in the world as a whole," he said. "There's a lot of pervasive weakness, not the least of which is the world's shaky financial condition."

A major factor that keeps oil prices high is tight supplies, and Netschert says there's lots of oil.

"When we see the bottom of the barrel, we'll be well into the 21st century," he said, adding it will become increasingly more expensive to get but that there's plenty.

Oil drilling in the United States has declined for seven consecutive months, largely because demand has been weakened further by the recession. Netschert predicts oil drilling will pick up when the economy improves because oil is still high-priced compared with what it cost 10 years ago.

He said the United States is still vulnerable to the Organization of Petroleum Exporting Countries and will be so for the rest of the century. The best way to combat that, he said, is to stock the country's Strategic Petroleum Reserve, which now contains about 250 million barrels. The Reagan administration's goal is to stock it to 750 million barrels, which Netschert said is roughly a two-month supply of all the country's oil needs.

When the world runs short of the easy-to-get liquid petroleum, it has incredible quantities locked up in shale oil and in heavy crude in Venezuela.

Reprinted with permission from *The Arizona Republic*.

ACTIVITY 13 - RESOURCE COSTS AND SUPPLIES

There are many statements which students could underline. Be sure they note:

1) *The connection between conservation efforts and supply of oil.*

2) *The need for focusing on "long run" effects of conservation. Bad habits change slowly.*

3) *The high cost of making bad projections in the oil business.*

4) *How closely a consuming (and intelligent) public watches industry projections in times of scarcity. (Knowledge of and discussion about conservation issues are key to their very success.)*

5) *America seems to have "learned its lesson"— moderate use will continue to the end of the century.*

6) *"There's lots of oil," but it will become more expensive to get.*

7) *The U.S. is still vulnerable to OPEC.*

8) *Basic geological information is important, but is only a part of the "equation" on oil.*

BEST COPY AVAILABLE

ACTIVITY 14

APPLYING TECHNOLOGY TO RESOURCE AND ENERGY ISSUES

Read this article and then answer the questions that follow it on page 112.

Petroleum companies are experimenting with esoteric new ways of forcing oil from subterranean hiding places, anticipating the day when the oil glut ends.

PUTTING THE SQUEEZE ON OIL

By PATRICK YOUNG

The oil-rich Permian Basin proved a petroleum bonanza for half a century as company after company sank wells and pumped the black gold lying deep beneath the arid lands of western Texas and southeastern New Mexico. But now that bonanza is playing out. The time is coming when all the oil that can be recovered with conventional techniques will have been pumped. So over the next few years, oil companies operating in the basin will begin injecting their fields with carbon dioxide, the common gas that puts the fizz in soft drinks and beer.

The carbon dioxide will mix with oil trapped in rock pores, thinning it to produce fluids that will flow more easily into producing wells. The vast effort will cost billions of dollars, but it is expected to extend the life of the Permian Basin 30 or 40 years and to yield billions of barrels that would otherwise never reach the surface.

"In the Permian Basin as a whole, there is going to be a significant increase in crude-oil reserves," says Lowell R. Smith of Amoco Production, Incorporated, a Standard Oil Company of Indiana subsidiary. "It is difficult to give an exact number, but it is not difficult to imagine the generation of an additional 10 billion barrels over the next few years."

Ten billion barrels at 42 gallons to the barrel is a lot of oil. Indeed, it is an amount equal to more than one-third of the United States' current proved recoverable oil reserves. So the gas that puts the pop in soda pop offers one way the nation can increase its declining oil supplies.

Carbon dioxide is just one of a number of exotic thermal, gas, and chemical techniques lumped under the general heading of enhanced oil recovery, or EOR. The oil industry has long explored the techniques in laboratory tests and pilot projects. But only recently have these complex and costly recovery methods begun coming into their own.

Currently some 375,000 — or 4.4 percent — of the 8.6 million barrels of oil produced daily in the United States come from EOR operations. But energy experts predict EOR could one day provide 20 to 30 billion barrels of oil from known fields in the United States that would otherwise be lost forever, and that EOR could add 100 to 200 billion barrels from existing fields world-wide.

Dwindling domestic reserves and the high costs of deep-ocean drilling and exploration in the Alaskan Arctic — the two places within U.S. jurisdiction most likely to harbor large undiscovered petroleum reservoirs — have heightened interest in EOR.

"Our inventory is being depleted," says John H. Guy IV, deputy executive director of the National Petroleum Council, an industry-funded advisory panel to the U.S. Department of Energy. "Either you find new discoveries in Alaska or offshore or you go back to known reservoirs and get more oil out."

The world oil glut and the resulting drop in petroleum prices have affected industry profits and delayed or slowed the opening of some EOR projects. "Drilling and exploration are way off, and EOR is just as far off," says Lloyd Elkins, an independent oil-industry consultant in Tulsa, Oklahoma.

But Guy says very few companies have cut back their EOR research. Whatever the supply and demand of the moment, oil reserves are finite. Few doubt that the oil glut will end and that demand will rise, increasing the need to squeeze ever-increasing amounts of petroleum from the ground and making EOR cost effective.

"I don't know of anybody in the industry that doesn't think EOR will come," Elkins says. "They are going to be ready and they are going to apply it."

EOR's importance lies in the fact that exploiting the world's oil deposits requires more than sinking a successful well. Contrary to common impression, oil doesn't collect in underground lakes or pools that can be pumped dry. Rather, it is trapped in the tiny holes of porous rock where natural

☞

underground pressures can force some of it to move. Occasionally these pressures are strong enough to push the oil to the surface to form a spectacular gusher.

These natural forces, known collectively as primary recovery methods, rely on the pressures of ground water or natural gas trapped in the petroleum reservoir to displace the oil and force it to producing wells. But these pressures alone usually allow the recovery of only a fraction of the oil in a reservoir, generally 10 to 50 percent.

Since World War II, the oil industry has increasingly bolstered production in aging fields by injecting large quantities of natural gas or water to supplement the natural reservoir pressures and keep the oil flowing. These secondary recovery efforts, however, can be extensive and costly.

Next summer, for example, the two operating companies at Prudhoe Bay on Alaska's North Slope will begin a "waterflood" project that ultimately will involve daily injection 8,000 feet underground of some 84 million gallons of water. This $2 billion secondary recovery project is expected to add 1.1 billion barrels of oil to the 8.5 billion barrels the field's owners expect to recover without it.

Secondary recovery has proved a boon. Yet experts estimate that conventional recovery — primary and secondary combined — will allow extraction of only 35 percent of all the oil underground on planet earth. Thus the growing interest in EOR methods, which could increase that figure to 45 or 50 percent.

"The strategic plan of any oil company has to include a comprehensive EOR program," says Robert A. Loosley, Conoco Incorporated's enhanced-recovery manager for North America. "We still need that oil. The oil is still there, and EOR is the only way to get it."

Briefly, then, here is a layman's look at the three basic EOR techniques — thermal, miscible, and chemical:

Thermal recovery, by far the most developed, now accounts for four out of every five barrels of EOR-produced oil, and almost all of that results from steam.

Crude oil thins as it is heated, making it flow easier. Injecting steam provides an effective way to thin oil, and over the past 20 years it has increasingly won its place in a number of fields, particularly those with thick, sluggish-flowing reserves.

Two techniques, known as steam stimulation ("huff and puff") and steam flooding, are used.

In huff and puff the steam is injected down a well for days or weeks and then turned off. The steam heats the underground rock and oil, thinning the oil and setting it flowing faster. The well pumps are then turned on to extract the oil that seeps into the well. When production drops, the oil gets another steaming, and the process is repeated.

Steam flooding, on the other hand, uses separate wells for steam injection and oil recovery. The steam is injected, heats the oil, and provides the pressure to push the thinning crude towards the producing wells. Often both techniques will be used in the same field, starting with steam stimulation and then going to steam flooding.

In situ combustion — literally the burning of some of the oil in a reservoir to provide heat — is a much newer thermal technique that is being explored. The idea, essentially, is that heat from the burning subterranean oil will vaporize lighter fractions in the crude in front of it. These will move ahead of the combustion zone toward producing wells.

The technique requires expensive compressors to inject the air needed to keep the oil burning. It is also difficult to control the burning, and when the combustion zone reaches a producing well, the well is destroyed.

"Within the industry there are mixed feelings [about in situ combustion]," Guy says. "Some feel its future is zero; others are strong backers."

Miscible means mixable. Oil and water don't mix, so they are not miscible. But there are liquids and gases that do mix well with oil when the conditions underground are right, freeing some of the crude remaining after primary and secondary recovery.

The carbon-dioxide projects planned in the Permian Basin are miscible recovery efforts. In other fields, liquefied petroleum gases such as propane, butane, and ethane can be used. Exxon Corporation has invested $109 million to inject nitrogen nearly three miles deep at the Jay field along the Florida-Alabama border to enhance production. And at its East Binger field southwest of Oklahoma City, Phillips Petroleum Company is using a mixture of nitrogen and carbon dioxide.

"It's something like flushing oil with gasoline," says A. J. Cornelius, Phillips's staff director for enhanced oil recovery. "You get a pretty good recovery from your reservoir rock."

Chemical recovery techniques use polymers, surface-active agents (surfactants), and alkaline compounds. They are the least developed — accounting for only 1 percent of the nation's EOR production — and generally the most expensive, but for some reservoirs they are the most promising of the EOR methods.

Polymers are large molecules mixed with water to thicken it so that the water flows with about the same viscosity as the oil. The result is a more uniform flow through the

"We're low technology around here."

111

69

BEST COPY AVAILABLE

reservoir and the displacement of oil missed by conventional secondary water flooding.

Surfactants are detergents whose actions below ground are somewhat akin to laundry products that wash grease from clothing. They are usually injected with salt water or a mixture of salt water and refined oil, and their potential for recovery stimulation is high. But surfactants are expensive, and they must be specially tailored to each field. A miscalculation can mean millions of dollars lost. And even when the formulation is right, the cost may be wrong. Phillips abandoned one planned surfactant project when it found its production costs would run $34 to $35 a barrel.

"And that wasn't allowing for any of our interest on the 8 million dollar investment," Cornelius says.

In fields where the crude is particularly acidic, sodium carbonate, sodium silicate, or sodium hydroxide may be injected. These alkaline compounds react with the petroleum acids to form surfactants underground. Conoco, for example, has built a $4-million plant to mix sodium hydroxide and water and inject it into its Grubb lease near Ventura, California. The company expects this will give it another 1.5 million barrels.

"It's washday for the Grubb lease," says John Kemp, manager of Conoco's Ventura Division.

EOR is expensive. Matching the right technique to an oil field is a complex and lengthy process that requires a detailed understanding of the reservoir's geologic and chemical properties.

"Reservoirs are kind of like people," says Amoco's Smith. "They all have different characteristics."

One and sometimes more pilot projects are necessary to test a proposed EOR technique. Moreover, the methods are costly in terms of equipment, materials, and skilled workers. They require huge investments long before they provide a payoff. And even after a successful pilot trial, an EOR effort may prove a financial failure. "There is a high risk in EOR," Elkins notes.

Yet the oil companies believe they must continue to explore, refine, and slowly apply EOR techniques. They foresee a time when squeezing U.S. reserves as dry as possible with EOR will become paramount.

"We're going to need to do it," says Arthur A. McArthur, a staff engineer with Texaco, Incorporated. "It's a fact of life: You've got to have the crude, or you're not in business."

Patrick Young helps draw down oil reserves in commuting to Washington, D.C., where he is national medicine and science writer for the Newhouse News Service.

Reprinted by permission of the author and, *American Way*, inflight magazine of American Airlines. Copyright 1983 by American Airlines.

List the specific technologies and techniques that petroleum companies will utilize to get more oil from existing reserves and resources.

1. *Steam stimulation ("huff and puff").*
2. *Steam flooding (steam injected in one well, oil extracted in another).*
3. *In situ combustion (burning the oil in the reservoir).*
4. *Pumping carbon dioxide (mixes with oil and thins it).*
5. *Polymers are pumped (thickens water in reservoir to flow like oil).*
6. *Surfactants (detergents).*
7. *Alkaline compounds (reacts with acidic crude oil).*

How does this article illustrate the components of the resource equation?

As supply goes down but demand remains high, price increases. As prices rise, what were once costly production methods suddenly become cost effective to pursue. Capital funding will now "flow" towards what once were "exotic" technologies, as in the case of "synfuels" in the 1970s. (Society, technology and supply/demand all interact to change the equation.)

ACTIVITY 15

SOME IMPORTANT FUTURE ENERGY ISSUES

1. Should future fuel prices be left to market forces with a minimum of government interference?

2. How are fuel prices related to:
   - Long-term dependence on foreign supplies
   - National and international prosperity
   - "Squandering our limited resources"

SEE NEXT PAGES

3. What are the pros and cons of some of the new energy alternatives?
   - Wind power
   - Nuclear power
   - Solar energy
   - Geothermal power
   - Coal

ACTIVITY 15 - SOME IMPORTANT FUTURE ENERGY ISSUES

1. Should future fuel prices be left to market forces with a minumum of government interference?

Answers will vary. An appropiate answer will attempt to balance the role of government and the role of the marketplace. The governmetn kept price controls on oil until 1981, thus sending incorrect "price signals" to American consumers and compounding the problem created by the Arab embargo. Likewise, the needy must have heating oil to survive and gas to get work.

The important point is to recognize that government is involved and will stay involved. The question is: how much government involvement is appropiate when the availabilty of "critical" material is at issue?

A discussion of decontrol of natural gas prices would be appropriate here, too.

2. How are fuel prices related to:

- Long-term dependence on foreign supplies:

As long as we depend on other sovereign nations to supply much-needed goods and services, we will not have complete control over prices. Diplomacy which emphasizes mutual interests between producing and consuming nations is key.

- National and international prosperity:

High oil prices "fueled" a global rollercoaster ride of inflation and recession during the 1970s. Oil supplies and prices will remain key ingredients in world econmic prosperity, or lack thereof.

- "Squandering our limited resources":

Oil didn't become scarce because it was "squandered." It became scarce because of wild jumps in price compounded by unwise government decisions. "Squandering" would apply if oil were the only source for future generations. Moreover, what uses classify as "squandering"? Discuss this last point.

3. What are the pros and cons of some of the new energy alternatives?

- Wind power:

Pros: *Wind (like sun) is abundant and free. No pollution.*
Cons: *Wind must blow at least 15 mph to be effective. Wind is intermittent. Large land areas are needed.*

- Nuclear power:

Pros: *Nuclear is pollution-free. Much power generated from small amount of fuel (less mining required). Cost-competitive with other forms of electric generation.*
Cons: *Safety of nuclear fission. Problem of radioactive waste. Public anxiety.*

- Solar energy:

Pros: *Fuel source is abundant, neverending and free. Active and passive systems don't require connection to utility grid system. Solar cells made from sand.*
Cons: *Still too expensive (solar cell and solar-thermal conversion) for widespread use. Generation during cloud cover. Large land areas required. Storage can be a problem, too.*

- Geothermal power:

Pros: *Both hot water and steam are usable directly. Pollution-free and renewable.*
Cons: *Source must be close to earth's surface to be economical. High mineral content at times (impurities). Requires large areas of land. Could lower underground water level, causing land to sink.*

- Coal

Pros: *Plentiful supply of necessary raw material. Known technology. Tradeoffs and externalities largely understood. Existing industry. Inexpensive.*

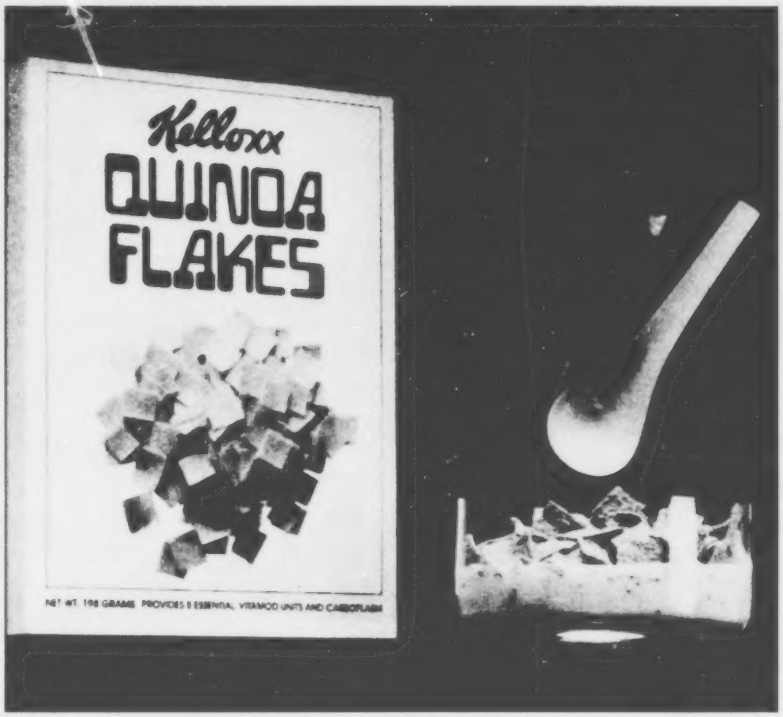
Cons: *Mining of raw material dangerous and creates unsightly areas. Burning coal pollutes the air. Existing debate over its use.*

ACTIVITY 16

ONE SOLUTION TO THE WORLD HUNGER PROBLEM

Read the article on the next page. Then answer the questions which follow on page 116.

Technology



Photograph: Carin Krasner

Goodbye, Corn and Wheat— Hello, Quinoa and Marama Beans

By Dennis Meredith

The next time you wield knife and fork in preparation for doing justice to a hearty plate of food, consider that, in the next few decades, you might find yourself sitting down in the morning to a bowlful of crisp, nutty quinoa flakes with sliced tamarillo, or amaranth toast with custard apple jam. Or maybe you'd prefer buffalo grass biscuits with a helping of calabaza, a little malanga or a dish of boniato. A night out at your favorite watering hole might find you chomping such munchies as toasted marama beans and, if you're brave, downing a potent quinoa liqueur.

There are literally dozens of incredible edibles that could come marching across your table in the near future, thanks mainly to a relatively small band of scientists combing the world in search of better crops. From the icy reaches of the Andes to the sizzling sands of the Kalahari desert, they're retrieving samples of exotic-sounding plants like quinoa and marama beans to grow in test plots and examine for nutritional quality.

You say you're a corn-potatoes-peas-and-carrots person, and won't touch anything you can't pronounce? Actually, you're already more cosmopolitan than you think, says Dr. Noel Vietmeyer, a researcher on new food crops at the National Academy of Sciences in Washington, D.C. "Times are changing. I predict that we're going to be relying on plants more and more [as our prime food source]—and we're going to be eating more species.

"If you don't believe that times are changing, I suggest you look in your own supermarket and at your own dinner table. You're already eating Mexican fruits, Chinese vegetables, avocados, artichokes, kiwi fruits, chili peppers, salad dressings with strange herbs and alfalfa and mung bean sprouts. These are foods that your grandparents never heard of and would never think of trying."

The dedication of scientists searching out new food plants comes from more than just a desire to tickle your taste buds; they're after crops that can better withstand drought and cold, preserve farmland and offer better nutrition to starving millions in underdeveloped countries, and to well-fed nations as well.

"We're realizing the environmental limitations to our ability to use land," says Vietmeyer. "We can't keep on irrigating more deserts and draining more swamps and spraying more pesticides just so we can keep planting our pampered crops in those areas. We have to select the plant to fit the environment, instead of changing the environment to fit the plant."

So far, we've been "grossly negligent" in combing the world for new food, says Vietmeyer. Of the eighty thousand or so edible plants thought to exist on our planet, we rely for 90 percent of our food needs on just *fifteen*—rice, wheat, corn, sorghum, millet, rye, barley, cassava, sweet potato, white potato, coconut, banana, common bean, soybean and peanut.

True, these foods have served us well. Our mainstays, corn and wheat, are nutritious, give high yields per acre and store well because of their low moisture content. And, because they are annuals, farmers can plant and harvest them before pests have a chance to multiply.

Our old familiar plant friends are not without their drawbacks, how-

ever. They are originally tropical plants, having been imported from South America thousands of years ago. Thus, they need warm temperatures and plenty of rainfall. As any farmer knows, a dry year or an early frost can be disastrous to the usual crops. The worst problem, though, lies in the fact that our major food crops *are* annuals, and their harvest in the fall makes fields vulnerable to erosion by the winter rains.

"Soil erosion is absolutely the most serious ecological problem in the world," says crop expert David Pimentel of Cornell University. "In the corn-producing areas of the United States, ten to twenty tons per acre of topsoil are lost each year." At this rate, says Pimentel, only a decade is required to wash away an inch of topsoil that took two hundred years to build up."

One solution is literally under our feet, says Pimentel. Throughout our country's grasslands are species of perennial grain-producing prairie grasses that could be turned to agricultural use. The Land Institute in Kansas is experimenting with such exotic-sounding plants as buffalo grass, foxtail barley, June grass, switch grass, bullrush sedge and salt marsh cord grass, all of which hold the soil and are more resistant to drought and cold than our imported tropical corn and wheat.

"Because they wouldn't have to till the soil, farmers would save seven to eight gallons of diesel fuel per year per acre by growing perennial grasses," says Pimentel. What's more, much of the $7 billion to $10 billion in fertilizer that's washed away annually would remain in the soil to do its work, he says.

Sometimes the "new" plants that agronomists check out as better food sources aren't new at all; they've only been lost to modern agriculture through foolishness. Take quinoa (pronounced kee-no-a), called the "grain of the Inca." More nutritious than corn or wheat, this hardy protein-rich grain was a staple of the ancient Inca empire. It was so revered that each year the mighty Inca ruler would plant the first row of quinoa with a solid gold spade, signaling the beginning of all agricultural planting throughout the land.

"The reason you don't know about quinoa has nothing to do with the plant itself, but with history," says David F. Cusack, who is laboring to bring quinoa to this country. According to Cusack, quinoa's decline began centuries ago when Spanish conquerors suppressed it, denigrating it as "Indian food."

Quinoa is coming back strong in South America, and Cusack and his colleagues at the nonprofit Sierra Blanca Associates in Boulder have started test plots of quinoa in the Colorado Rockies. Their results so far indicate that the hardy, drought-resistant plant could come to occupy considerable space in farmers' grain bins—and on our tables.

Then there are food plants that weren't lost—in fact, they've never really been found, at least not by farmers. One of these, the marama (pronounced mar-ah-ma) bean, grows wild in the Kalahari Desert of southern Africa, and so far has been enjoyed primarily by members of nomadic tribes, who gather its nutlike seeds.

If anthropologist Joseph Bousquet has his way, we'll all get a chance to enjoy marama beans grown on formerly useless desert lands in our own Southwest. Working at Southwest Texas State University, Bousquet has induced several institutions to begin test plots of marama in this country to discover the ideal cultivation conditions. Also, researchers in other countries, including India, Africa, Israel, Australia, England and France, are beginning to study this new plant as a drought-resistant food source.

The biggest question, though, is whether we'll be willing to eat such new plants. After all, we've discriminated against perfectly good foods in the past because of pure personal prejudice. Of one food, an English author wrote in 1708 in the "Gardener's Kalendar" that "the root is very near to the Jerusalem artichoke, although not so good and wholesome, but it may prove good to swine." He referred to the potato.

And in 1820, one Robert Gibbon Johnson offered to stand on the steps of the courthouse in Salem, New Jersey, and publicly eat another food that everybody *knew* was poisonous. A large crowd turned up, expecting him to die from eating a tomato.

Reprinted courtesy of *Republic Scene* magazine carried aboard REPUBLIC AIRLINES. Copyrighted 1983. East/West Network, Inc. publisher.

1. Why are famine and malnutrition much less common today than at the beginning of the Great Transition?
Students should cite:

- *Scientific knowledge has helped discover new kinds of foods, and helped us to steadily increase yield and production of existing crops.*
- *Technology has made farming fast and relatively easy.*
- *Society is better organized, able to get food to needy citizens.*
- *Literacy has helped the world's people to learn about diet and nutrition.*

2. How can technology help solve hunger problems?
Areas could include:

- *Increasing yield through new hybrids.*
- *More effective fertilizers and pesticides.*
- *Improving farm machinery.*
- *Using modern transportation to get food to the needy more quickly.*
- *Using modern communication to teach farmers about innovative methods, and informing the world community about constructive ways to address problems.*
- *Development of better (longer term) food storage techniques.*

3. What is the relationship between a developing country's exports (and its economic growth in general) and the hunger problems that some of its people may experience?

A developing country might choose to export a foodstuff it produces even if its own hungry citizens might be in need of that food. That is, the leaders of a country could decide that trade is essential to the country's well-being, even if it occurs at the cost of a hungry populace. Often, the "image" of development is important: to be perceived by other nations as competitive in world markets will prompt a nation to trade away much-needed food. Unfortunately, famines have been caused by this practice of emphasizing trade with developed nations "at all costs."

Ultimately well-fed citizens are an essential part of a nation's productivity.

4. What "new" foods look promising for supplying foods in the future? (You'll need to do library research to answer this question.)

Answers will vary, depending on student research. Focus attention on items which will satisfy basic nutritional requirements.

- *Certain seaweeds (high in protein) are now being eaten in Japan, and other Far Eastern countries.*
- *Unconventional sources of protein are being developed: "artificial meat" made from soya meal; fish-protein concentrate, an odorless flour for mixing with other foods; food yeast from the byproducts of pulp and paper manufacture.*
- *Chlorella, an alga that multiplies at a tremendous rate, would be a virtually unlimted supply of protein.*

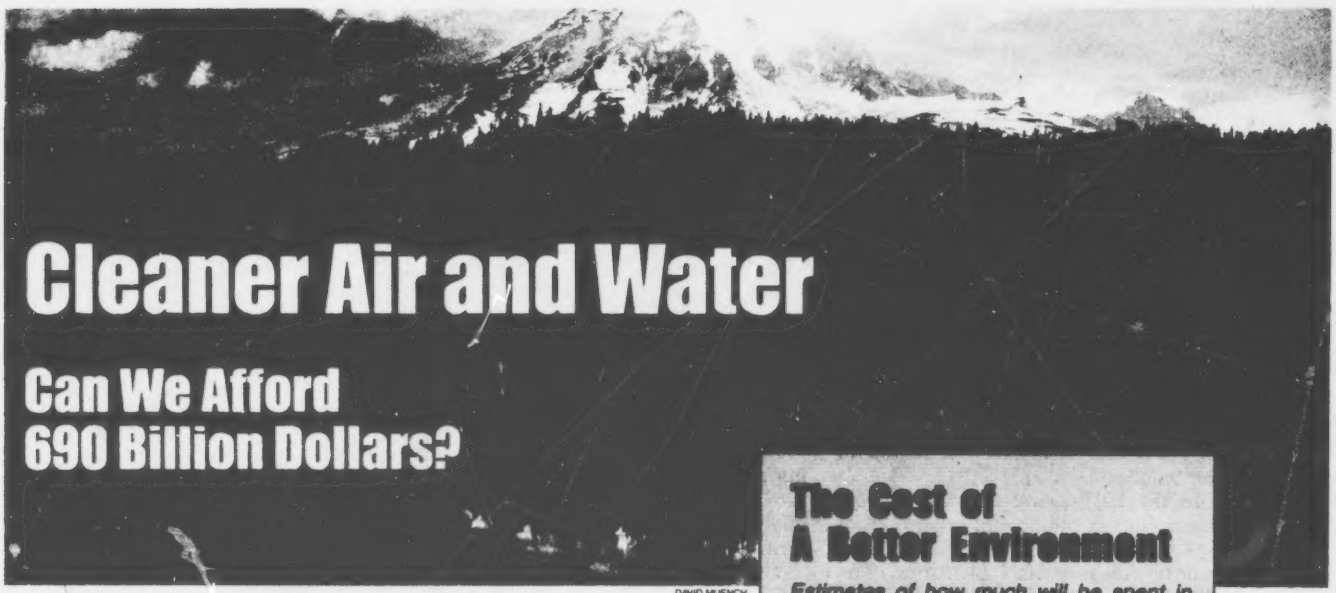
The key is public acceptance ana cost. However, tastes are changeable. (See the article with regard to attitudes toward the potato and tomato.)

ACTIVITY 17

ENVIRONMENTAL TRADEOFFS AND EXTERNALITIES

Read the two articles that follow. How does each illustrate the concepts *tradeoffs* and *externalities?* In each case, the people affected need to make choices. What choices would you make? Why?

Reprinted from U.S. News & World Report



Cleaner Air and Water

Can We Afford 690 Billion Dollars?

DAVID MUENCH

The environment is in its best shape in years. Now comes the toughest part—the final costly steps to protect people and nature from the backwash of progress.

The uproar over the goals and methods of the Environmental Protection Agency throws a spotlight on a national crusade against pollution that has reached a crucial turning point.

Nearly 15 years after Earth Day ushered in the era of environmentalism, progress in cleaning up the United States is undeniable. Air in 20 major cities is measurably cleaner than it was before passage of the Clean Air Act in 1970. Fish are swimming in lakes and streams that a few years ago were devoid of life. Government and industry are spending 50 billion dollars a year—$220 for every man, woman and child in the U.S.—to reduce pollution.

Yet the nation still faces serious obstacles to making the environment even cleaner, and some people are skeptical that the goal is worth the tremendous cost in money, time and lost jobs. The EPA reports that 111 of the nation's 3,000 counties, most of them in major metropolitan areas and with a total of more than 50 million people, failed to meet a January 1 deadline for complying with federal air-pollution standards. Attaining fishable, swimmable waters by July 1—goal of the 1972 Clean Water Act—seems equally unlikely in many places.

Frightening incidents at Niagara Falls, N.Y.—and more recently at Times Beach, Mo.—have focused attention on a new generation of environmental hazards that defy easy solution: Dangerous wastes.

Some 800 families had to leave Niagara's Love Canal area in 1979 after health experts linked unusually high rates of illness and death there to chemicals leaking from an old industrial dump.

In recent months, another alarm was sounded in the St. Louis suburb of Times

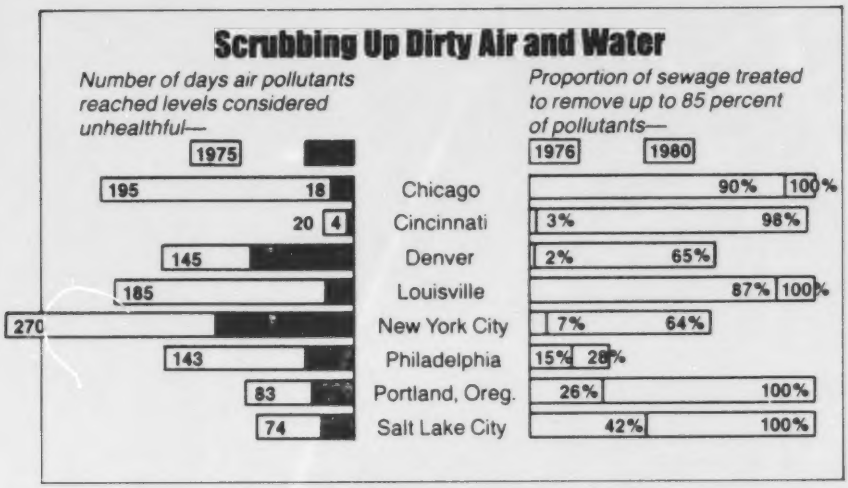
The Cost of A Better Environment

Estimates of how much will be spent in 1980-89 to combat pollution, stated in constant 1982 dollars to discount the effects of inflation—

Air pollution	$393 bil.
Water pollution	$228 bil.
Solid-waste pollution	$ 22 bil.
Land reclamation	$ 19 bil.
Noise	$ 11 bil.
Toxic substances	$ 11 bil.
Drinking water	$ 4 bil.
Pesticides	$ 2 bil.
TOTAL COST, 1980-89	**$690 bil.**

Outlays in the 1980s—more than two thirds to be spent by industry—will exceed those of the '70s by 53 percent.

USN&WR—Basic data: USN&WR Economic Unit estimates



Beach over waste oil laced with dioxin —one of the most toxic man-made substances and a suspected cause of cancer—that in the early 1970s was sprayed on Missouri roads to keep down dust.

Like a buried time bomb, the poison lay just below roadways for 12 years before this winter's floods flushed it through the small town. Estimated cost of relocating residents and removing the contamination: 47 million dollars.

The cost of cleaning up Times Beach is only a fraction of what will be spent in coming years on problems that were not foreseen when environmental laws were being written in the last decade.

Use of a 1.6-billion-dollar, industry-financed Superfund for cleaning up hazardous-waste dumps lies at the heart of the current EPA blowup.

Experts warn that it will be enormously difficult and costly to cope with acid rain and depletion of ozone in the atmosphere, protect workers from occupational health hazards, remove deadly chemicals from water supplies, clean up long-abandoned toxic-chemical dumps and store radioactive waste.

Comments Lester Brown of the Worldwatch Institute: "We've made encouraging progress, but we're not home free yet. We know about pollution from smokestacks, and so we've controlled that pretty well. But we're just learning about the effects of synthetic chemicals. We may be chasing them down for as long as you and I may live—or at least for the indefinite future."

In the 1970s, an estimated 450 billion dollars in public and private funds was spent in the drive to make the country cleaner and healthier. The Economic Unit of *U.S.News & World Report* estimates that government and business will need to spend 690 billion more during the 1980s. Much of the cost may be borne by some of the most depressed industries: Steel, auto, rubber and other heavy manufacturers.

Is a cleaner America worth the price?

Says Lester Lave, a Carnegie-Mellon University economics professor: "It costs as much to go from 95 to 97.5 percent control of pollution as it did to get to the 95 percent removal stage. In order to go that extra increment, you have to install new technology."

Checking opinions. Business doubts about cost vs. benefits of a cleaner environment apparently are not shared by the public. A survey by pollster Louis Harris in December found that 65 percent of those interviewed want industry to install the best water-pollution-control equipment available—even at the expense of jobs.

In a comprehensive public-opinion survey of environmental and economic issues that was sponsored by the Continental Group, Inc., a Stamford, Conn., firm, 77 percent of the respondents put a high priority on a clean environment, even though 70 percent believed they have been hurt by the recession.

Public support for the environment also is reflected in the growing political power of groups such as the Wilderness Society and the Sierra Club. In last November's election, 34 of the 48 congressional candidates backed by environmentalists won. Responding to public opinion, Congress has rejected nearly all attempts by the Reagan administration to relax environmental laws and regulations.

Yet translating public support for antipollution programs into results is likely to prove difficult, as the following reports suggest. □

By RONALD A. TAYLOR

Copyright © 1983, U.S.News & World Report, Inc.

Tacoma Gets Choice: Cancer Risk or Lost Jobs

By PHILIP SHABECOFF
Special to The New York Times

WASHINGTON, July 12 — The Environmental Protection Agency today asked the citizens of Tacoma, Wash., to take part in a difficult decision: Should they accept some risk of cancer from arsenic in the air rather than face the probable closing of a copper smelter that provides 800 jobs?

The agency proposed a new standard to limit emissions of arsenic into the air but also conceded that the new rules would entail risks to health. Although the proposed standard would apply nationwide, it would chiefly affect Tacoma because the copper smelter there is the only one in the country that uses ore with high arsenic content.

In what William D. Ruckelshaus, the Administrator of the environmental agency, described as a new policy of involving the public in the agency's task of managing the risks of pollution, an intensive campaign has begun to inform the citizens of Tacoma about the proposed health standard, its risks and about the alternative: closing the plant if the risk is to be eliminated entirely.

At the end of the campaign, the citizens will be asked to give their opinions at a series of public hearings. In an interview, Mr. Ruckelshaus said that, while the final decision on the proposed standard would be his, he would give the views of the citizens heavy weight.

He also said he would welcome any proposal that would offer a solution other than a relatively high cancer risk or closing the smelter, which is operated by Asarco Inc. As an air pollutant, arsenic, a deadly poison, has been found to cause lung cancer and other illness.

"For me to sit here in Washington and tell the people of Tacoma what is an acceptable risk would be at best arro-

Continued on Page A12, Column 4

Tacoma Weighs Risk and Jobs

Continued From Page A1

gant and at worst inexcusable," Mr. Ruckelshaus declared.

He said he was not taking a referendum but would see if a consensus emerged from the public meetings and mail after the people of Tacoma were informed of the choices. "I don't know what we'll do if there is a 50-50 split," he added.

The new arsenic standard, which was required as of Monday under a Federal court order issued last January, requires the use of "best available technology" to reduce emissions of arsenic at the Asarco smelter, as well as at other copper smelters and some glass plants around the country.

The standard would require the Tacoma smelter to lower its arsenic emissions to 172 million grams a year, from 282 million grams.

The agency reported that the risk of contracting lung cancer for people most exposed to the levels of arsenic now being emitted from the smelter were about 9 in 100 over a lifetime. The estimated number of lung cancers in Tacoma produced by arsenic emissions from the plant are about four a year, the agency said. From 71 to 94 people die each year of lung cancer from all causes in Tacoma, the agency said.

The new standard would lower the chances of contracting lung cancer by the most exposed population to 2 in 100, according to the agency. The estimated increase in lung cancer in the Tacoma area from the emissions would be reduced to one a year.

Mr. Ruckelshaus noted that by public health standards, these are still high-risk levels. He also noted that the Clean Air Act of 1970 calls for the establishment of standards that afford the public an "ample margin of safety" from toxic air pollution. But he said that in the case of a cancer-causing agent such as arsenic, there was no known threshold of safety.

Risk could not be eliminated entirely, therefore, without eliminating the emissions, he said. In this case, according to E.P.A. calculations, the risks could not be reduced further without undermining the economic viability of the smelter, which is said to pump about $20 million a year into the local economy.

In a statement, Asarco said it would spend $4.4 million to meet the new arsenic standard.

The statement disputed the environmental agency's contention that emissions from the plant increased the incidence of lung cancer in the Tacoma area, saying that monitoring data had shown no increase in cancer in the area.

David D. Doniger, a senior attorney for the Natural Resources Defense Council, a nonprofit environmental group, said the health risks under the new standard remained "very, very high."

He said, "No one wants to close a plant, but these risks are really too high to tolerate," Mr. Doniger said, adding that he was not convinced that the plant had to be closed to lower the risk.

Copyright 1983 by the New York Times Company. Reprinted by permission.

BEST COPY AVAILABLE

ACTIVITY 17 - ENVIRONMENTAL TRADEOFFS AND EXTERNALITIES

How does each article illustrate the concept of tradeoffs and externalities?

Points for discussion:

Tradeoffs

- *The USNWR article points out the large majority of people who are polled favor environmental protection at the expense of jobs.*

- *The New York Times article is about precisely that tradeoff: the people themselves will (somehow) have to decide.*

  (How should the decision about such a trade-off be made? The EPA will not hold a referendum in Tacoma. Will mail be a balanced means of assessing citizen desires? Are polls accurate enough?)

- *USNWR says that it costs as much to achieve 2.5% more control over pollution as it did to achieve the initial 95% control. Is it worth twice the price?*

- *New York Times says that there is "no known threshold" of safety for arsenic. Can there be an "all-or-nothing" tradeoff? Is a known but limited cancer risk worth a tradeoff for limited economic growth?*

Externalities

- *Many externalities have been caused by economic growth for several decades — this is the crux of many of our "environmental problems." Who should pay for the externalities caused by industries? Did we all benefit from the economic growth which externality-producing industries were responsible for? (Acid rain is a good example of "who-caused-it-and-who-should-pay" dilemma.)*

- *The New York Times article focuses on specific externality caused by copper smelting in Tacoma: arsenic. Are there positive externalities caused by Tacoma's smelter? Should all the citizens of Tacoma be involved in deciding about whether to keep the plant open, since the arsenic is airborne? Do those who stand to lose jobs have a higher stake, and therefore "more" of a vote in the decision?*

Encourage students to think on the questions listed here. Do not allow them to be too sure of their own "choice," at least before they have considered the full scope of the dilemma.

RESOURCES FOR THE FUTURE

66. A "resource" is . . . *(d)*
    (a) the sum of raw materials available
    (b) the applications of technology
    (c) people, skills, money, and institutions
    (d) all of the above

67. A raw material is not a "resource" until society has learned _____. *(how to use it)*

68. Another word for the money invested in a project or a new technology is . . . *(b)*
    (a) resource (b) capital (c) ore (d) power

69. Mineral mines sometimes close because the _____ for that mineral is too small or the _____ of that mineral are too large. *(demand...supplies)*

70. Some people urge that we must limit our use of raw materials. The primary reason they give is . . . *(a)*
    (a) we will run out of raw materials
    (b) there is not enough demand
    (c) there is too much supply in relation to demand
    (d) it is more important to feed a growing population

71. The portion of total resources that we have already found and can profitably use is called . . . *(c)*
    (a) ore (b) supply (c) known resources (d) demand

72. Many of the reports that indicate we are running out of raw materials do so, because . . . *(a)*
    (a) they only consider known resources
    (b) people are pessimistic
    (c) they have used computers
    (d) they have failed to research the facts

73. Estimates of the amount of "known resources" for a material change as we develop new ways of _____ the material. *(finding or developing)*

74. If a raw material becomes scarce, we can . . . *(d)*
    (a) try to decrease demand
    (b) raise the price
    (c) develop new technologies for using it more efficiently
    (d) all the above

75. Trying to do the same job, using less of a resource is called _____. *(conservation)*

76. One thing that can be done to overcome a shortage of a raw material is . . . *(d)*
(a) conservation (b) substitution (c) develop a new technology (d) a, b and c

77. For at least 100 years, the cost of raw materials, relative to wages, has . . . *(b)*
(a) increased (b) decreased (c) remained the same (d) fluctuated

78. The Arab oil embargo of 1973 taught us . . . *(d)*
(a) nations are interdependent
(b) people are adaptable
(c) an oil embargo is not the same thing as "running out" of oil
(d) all the above

79. Since we have learned to conserve oil, demand has _____. *(decreased)*

80. Social problems are solved the same way they are created, by . . . *(a)*
(a) society choosing laws and policies it wants
(b) an embargo
(c) decreasing production
(d) increasing demand

81. "Real" costs must be expressed in . . . *(a)*
(a) constant dollars (b) dollars (c)terms of productivity (d) terms of GNP

82. "Constant dollars" are prices which have been . . . *(d)*
(a) fixed
(b) translated into international currencies
(c) used to express GNP
(d) adjusted for inflation

83. A "countervailing force" is one that . . . *(b)*
(a) continues a trend
(b) reverses a trend
(c) predicts a trend
(d) invests in a trend

84. By giving people tax credit for installing solar heating and cooling devices, the government is encouraging us to _____ oil and gas. *(conserve)*

85. Examples of an "alternative" energy resource include . . . *(d)*
(a) wind and water power
(b) geothermal power
(c) nuclear fusion and nuclear fission
(d) all the above

86. An oversupply of a resource is called a _____. *(surplus)*

87. Since 1950, world food production per person has steadily . . . *(c)*
(a) doubled (b) fluctuated (c) increased (d) decreased

88. Is there enough food produced each year to feed all the people of the world? *(c)*
(a) No.
(b) No one has ever figured it out.
(c) Yes.
(d) It's debatable.

89. People starve, not because there isn't enough food, but because of . . . *(d)*
(a) economic reasons (b) political reasons (c) problems of distribution (d) a, b and c

90. We produce so much food in the U.S. that the government actually pays farmers _____. *(not to grow it)*

91. Food can be produced for domestic consumption or for _____to other countries. *(export)*

92. Per capita food production is increasing in . . . *(c)*
(a) low-income countries (b) wealthy countries (c) worldwide (d) middle-income countries

93. "Aquaculture" refers to growing food in _____. *(water)*

94. A steward is someone who _____ another's property. *(b)*
(a) uses (b) manages (c) exploits (d) sells

95. Unpredicted results, which can either be helpful or harmful are called . . . *(b)*
(a) mistakes (b) externalities (c) prophecies (d) none of these

96. The most difficult externalities to correct are those where no one _____ can be identified. *(c)*
(a) solution (b) result (c) cause (d) waste product

97. If benefit results from the destruction of something, this is sometimes called "_____ destruction." *(creative)*

98. U.S. wildlife areas and recreation lands have _____ since 1900. *(a)*
(a) increased (b) decreased (c) been destroyed (d) remained the same

99. In order to make a good decision about the environment, you need to examine . . . *(d)*
(a) the objective of a project (b) the benefits of of a project (c) who will enjoy the benefits (d) a, b and c

ACTIVITIES: PROBLEM SOLVING IN A TIME OF CHANGE

ACTIVITY 18

MORE ON THE GREAT TRANSITION

A. *Trends of the Great Transition*

The events of the Great Transition are not just historical ideas. They have relevance and immediacy in your own life. The changes that are occurring in the United States at present, and that will occur during the next decades, will profoundly affect how you will spend your time in the future. Your worktime, leisure time, and family time could all be affected.

What are the *long-term* trends of the Great Transition? (In Unit II, you learned that population growth, economic growth, and growing control over nature are the major characteristics of the Great Transition. In the second half of the Great Transition, the trends begin to change as societies become super-industrial and post-industrial.)

1. With regard to *population*, the major trend of the second half of the Great Transition seems to be:

Answers should include two points:

- *Population growth rates will slow down during this phase of the GT.*
- *People will live longer lives.*

2. With regard to *economic growth*, the major trend of the second half of the Great Transition is:

Answers should include:

- *A rising "economic tide" should help both developed and developing nations to prosper.*
- *All nations will grow more interdependent economically.*

3. With regard to *technological change*, the major trend of the second half of the Great Transition is:

Answers should include:

- *Advances in technology will continue and multiply, creating more "spinoff" effects.*
- *Technological advances will expand career choices and enhance leisure time.*
- *Change will occur very rapidly.*

B. *Possible Changes in My Life*

How might each trend affect *your* life? Jot down your predictions below.

Population

The population trends of the Great Transition could affect my employment in these ways:

More people will be alive, and they will live longer. Medical and social services will grow in importance. Leisure time industries will flourish. (In post-industrial societies, periodic "baby booms" may be a reoccurring phenomenon. Thus, people born in the 1950s have many competitors in the job market now because their age "cohort" is larger. People who are high school students today are members of a less opulent cohort, so competition for jobs will be less.)

My personal life could be affected in these ways:

Areas to be emphasized include:

- *What individuals will do during their longer lives: leisure and recreation.*
- *How they will be employed: careers and career changes.*
- *Marriage and family life.*

Economic Growth

The economic trends of the Great Transition could affect my employment in these ways:

Areas to be emphasized include:

- *How increased personal wealth will effect one's need or desire to work fulltime.*
- *How increased wealth will enable one to retrain for a new job.*
- *The effect of world economic growth on individual job potential—the growing number of Americans working for (or in) foreign countries.*

My personal life could be affected in these ways:

Students could focus on:

- *The possible onset of "laziness" or lack of initiative, due to having so many of one's needs (and wants) satisfied.*
- *The growth in personal spendable income ("discretionary income"), and how that might change wants into "needs."*
- *One's individual desire to share personal wealth with those less fortunate. As more people have more wealth, they tend to become more aware of the relative poverty of others.*

Technological Change

The technological changes of the Great Transition could affect my employment in these ways:

Answers will vary, and could touch on:

- *How one's existing job may be changed by technological advances - microcomputers, robots, etc.*
- *How new technologies will offer opportunities for retraining in different occupations - more skilled and less arduous tasks.*
- *The effect of automation on the length of time one actually spends at work.*
- *The possibility of "cottage industries" - working at home (see opening "scenario" in first VOF Unit).*

My personal life could be affected in these ways:

Answers will vary. Creativity of response should be encouraged.

- *Effect of personal robots on lifestyle.*
- *Effect of increased automation on daily "chores," and effect of increased dependence on technology. (See opening scenario.)*
- *How technology tends to "insulate" us from nature - both from its terrors and its beauties.*
- *How individuals may come to rely on technology to take care of difficult interpersonal dealings and controversies.*

ACTIVITY 19

GLOBAL PROBLEMS

A. *Identifying the Problems*

There are basically two categories of problems which characterize the Great Transition: *mostly understandable problems* and *basically uncertain problems*. Based on your understanding of these two categories, define each and list at least three examples.

Mostly Understandable Problems are defined as problems which:

_____

_____

_____

_____

Basically Uncertain Problems are defined as problems which:

_____

_____

_____

_____

SEE NEXT PAGES

Some examples are:

1. _____
2. _____
3. _____

Some examples are:

1. _____
2. _____
3. _____

B. *Explaining the Problems*

Select *one* of the "mostly understandable" problems that you named. In the space below, explain the problem. (You may want to review some of the "issues" from other units.)

C. *Solving the "Understandable" Problems*

A "Scotch Verdict" has been reached concerning the "mostly understandable" problems: they can be solved. Unless we have a lot of bad luck and bad management, they probably *will* be solved.

With these thoughts in mind, you should be able to write a realistic prediction about how understandable problems can be solved. Choose one of the mostly understandable problems you named. Then, write a one-to-three paragraph prediction about the status of that problem in 2030 (just about 50 years from now, about the time you will probably be retiring from fulltime employment!). Your prediction should utilize known facts, as well as Scotch Verdicts about the problem, and should be persuasive and well thought out. Try to convince the reader that *your* 'vision of the future' is one that is likely to occur.

A. Identifying the Problems
Mostly Understandable Problems are defined as problems which:

Anwers should cite three aspects: 1) We understand the problem, 2) so we think we know how to solve the problem, and 3) if we just decide to do it.

Basically Uncertain Problems are defined as problems which:

Answers should relate to three aspects of "mostly understandable problems": 1) we do not fully understand the problem, 2) therefore we cannot easily solve the problem, and 3) it is unclear whether we will be willing to solve it.

Some examples are (mostly understandable):

1. *Population growth*
2. *Raw materials scarcity, and other resource issues*
3. *Acceptable health levels for the environment*
4. *Shift of society's economic base*
5. *Effects of advanced technology*

Some examples are (basically uncertain):

1. *Changing values, resulting social problems*
2. *Environmental catastrophies*
3. *Weapons and terrorism*
4. *Completion of the Great Transition*
5. *Bad luck or bad management*

B. Explaining the Problems (Note: all five examples are listed here)
Select one of the "mostly understandable" problems that you named. In the space below, explain the problem.

1. *Population growth: answers should mention that world population growth rate has been declining since the 1960s. As countries industrialize their growth rate slows even more. The earth can sustain the growing numbers.*

2. *Running out of raw materials: answers should mention the resource equation. Even if some materials grow scarce, new technologies will "change the equation." Changes and adaptations will cause periodic problems for societies, but we can deal with it.*

3. *Acceptable health levels for the environment: answers should mention tradeoffs and externalities. We can improve our environment, if we are willing to pay for it.*

4. *Shift in society's economic base: answers should note the "transitional" and temporary nature of job shifts and job changes caused by super-industrialization. Retraining will be common.*

5. *The effects of advanced technology: answers should mention technology's potential for "dehumanizing" its users. However, technology is essential for our future progress, and we control it, not vice versa.*

C. Solving the Understandable Problems

Write a one-to-three paragraph prediction about how understandable problems can be solved.

Answers will vary. Examples:

1) Problem: Population growth

Prediction: By 2030 the U.S. population will be at "zero population growth."

Facts:
1) *U.S. population growth rates have been steadily declining for over a century.*
2) *People in the U.S. often choose to "lavish" many more things on their children; thus they decide to have fewer children.*
3) *In the 1990s the U.S. approached "zero population growth." People began to feel that Americans were "a vanishing breed," so they began to have children again. This brought the rate back up.*

There is a Scotch Verdict about the fact that population rates are coming down. Whether any one country would achieve zero growth is hard to predict with certainty. It is a function of many complex societal factors.

2) Problem: Raw material scarcity

Prediction: We will not run out of food in the future, but distribution problems will still cause some local problems.

Facts:
1) *Agricultural production and storage techniques create more food per capita each year.*
2) *Greater world interdependence will lead to more efficient trade policies.*
3) *Economic growth will enable poorer countries to afford foodstuffs.*
4) *The Food and Agriculture Organization (FAO) sets up worldwide food reserve system.*

There is a Scotch Verdict in making this prediction. The only uncertainties are political: will people decide to do what is needed.

3) Problem: Acceptable health levels for the environment

Prediction: By 2030, pollution-free cars will be mandatory in the U.S.

Facts:
1) *Battery-powered and hydrogen-powered cars are being developed and will soon be economically viable.*
2) *Air pollution grows to the point where public dissatisfaction solidifies: legislatures mandate that cars cause no air pollution by the year 2030.*
3) *The U.S. automakers and oil companies are forced to move in the pollution-free direction by overwhelming public pressure.*

This prediction could be made as a Scotch Verdict, but the uncertainties are political, not technical. Public concern about pollution has been strong and growing for two decades, and the future looks like "more of the same."

4) Problem: Shift of society's economic base

Prediction: By 2030, the U.S. Department of Labor has centers around the country for free retraining of workers.

Facts:
1) *The number of "heavy industry" workers dislocated by the move to "high tech" in the 1980s becomes large.*
2) *The unemployment insurance provisions for taking care of these unemployed reaches alarming cost levels.*
3) *American society decides that retraining should be done at public expense.*
4) *Both declining and rising industries support these retraining centers enthusiastically.*

Given present trends, both in society's attitude toward work and in the effect of "high tech" growth on "heavy tech" industries, each of these facts would be a Scotch Verdict.

5) Problem: The effects of advanced technology

Prediction: By 2030, all business transactions done by video must involve human interaction.

Facts:
1) *By 2030, the "videotex" revolution has taken place. All shopping can be done at home.*
2) *By 1990, videotex transactions grow troublesome and inefficient due to impersonality. One is always "talking to a computer."*
3) *Public pressure mounts, forcing government to mandate that efficiency increases be "traded" for public psychic health.*

This prediction involves the intersection of two trends, each of which we have a Scotch Verdict about: 1) the growth of videotex, and its obvious efficiencies over today's shopping methods and 2) the growing concern about the impersonality of a "high tech" world. One could say with Scotch Verdict certainty that some such compromise will be attempted.

NOTE: These predictions all emphasize relatively benign outcomes. If students make more negative predictions, that is perfectly appropriate. The goal of this exercise is to learn to make defensible predictions. (You might suggest the topics of the predictions to students, and challenge them to generate the facts and ascribe the levels of certainty.)

ACTIVITY 20

CAREERS OF THE FUTURE

A. *Employment Trends in the Great Transition*

What jobs will be available in the near future? In the long-term future? What areas of employment will be less important in the future? Review your text, read some articles on careers, then make the lists noted below.

JOBS THAT WILL NOT BE AS IMPORTANT IN THE FUTURE *Answers will vary. Encourage students to focus on present (and future) sectors of the economy.*

1. *Automobile Assembly Worker*
2. *Miner*
3. *Steel Plant Worker*
4. *"Lumberjack"*
5. *Fisherman*

JOBS THAT WILL BE VERY IMPORTANT IN THE FUTURE

1. *Engineer*
2. *Computer Technician and Programmer*
3. *Social Worker*
4. *Energy Technician*
5. *Paramedic*

B. *Working to Solve Problems*

You know there are problems that must be solved. Some we understand. Some are largely unknown. We can imagine both positive and negative future scenarios. But are there any specific actions we can take?

One specific action is to prepare for an occupation in a field which contributes to *problem solving* in one of the critical areas. Fill in the chart on the next page. What work in each of these areas do you think you might enjoy?

PROBLEM AREA	SOME OCCUPATIONS THAT COULD HELP SOLVE THE PROBLEMS
Climate changes	*Meteorologist, Pilot (cloud seeding), Oceanographer, Vulcanologist, Computer Programmer*
Adverse effects of technology (e.g., people losing jobs)	*Retraining Expert, Social Psychologist, Counsellor, Advocacy Planner, Computer Programmer*
Mismanagement of the economy	*Economist, Certified Public Accountant, MBA (Business Administration)*
Embargo of oil supplies	*Diplomat, Petroleum Engineer, Linguist, International Affairs Expert, International Trader*
Air pollution	*Scientist, Politician, Industrial Engineer, Government Worker (EPA)*
International cooperation over the use of outer space	*Aerospace Engineer, Diplomat, Linguist, Astronaut, NASA Employee*

C. *Preparing to Work*

Could your future occupation involve you in problem-solving?
Choose an occupation that interests you. Then answer the following questions about the occupation:

1. What training is required?
2. What tasks do jobholders in this field accomplish?
3. What are some advantages/strong points about the job?
4. What are some disadvantages/weak points about the job?
5. What are the future prospects for the job?
6. Is this really a good job for your future? Why or why not? Some good resources are the *Occupational Outlook Handbook* (your Librarian will help you), and the careers section of your library (use the card catalog).

Write your answers to the question below:

OCCUPATION: *Aerospace Engineer*

1. *Training:*

   Bachelor's degree in engineering or engineering technology (practical application). Experienced technicians can sometimes advance.

2. *Tasks:*

   Aerospace engineers design, develop, test and help produce commercial and military aircraft, missles and spacecraft. They specialize in areas like structural design, navigational guidance and control, instrumentation and communication, or production methods.

3. *Advantages:*

   The jobs are "clean" and highly technical. The job field is growing rapidly, and job security is better than average.

4. *Disadvantages:*

   An advanced degree may be necessary. The work is technical. The field is highly competitive. (Note: These "disadvantages" will depend on a student's temperment and career aspirations.)

5. *Prospects:*

   68,000 aerospace engineers were employed in 1980. The numbers are expected to grow rapidly, as work on new missles, aircraft, and helicopters increases. Many will be needed for attrition in growing industries as well.

6. *My Future:*

   Answers will vary. Encourage students to at least list three possibilities they find appealing now.

ACTIVITY 21

THE EFFECTS OF TECHNOLOGY

You have read that the development of new technologies can solve existing problems and create new problems. Some people feel that new technologies will "dehumanize" our society.

Read the two articles that follow. Then, answer these questions.

1. Give specific examples of how technology could "dehumanize" society.

SEE NEXT PAGES

2. In what ways could this "dehumanization" be bad?

3. In what ways could this "dehumanization" be good?

4. How will problems of the "dehumanization" by technology be countered?

1. Give specific examples of how technology could "dehumanize" society.

Focus on: how technology tends to isolate us as individuals, how it "depersonalizes" personal and business interactions, how it makes us less dependent on other people and more dependent on machines (e.g., 24-hour banking machines and increased time watching TV per capita). Suggest these topic areas, and encourage them to think of examples in their daily lives.

2. In what ways could this "dehumanization" be bad?
3. In what ways could this "dehumanization" be good?

Answers will vary. Discuss what "humanization" may mean. Is humanization changeable? Are we becoming different kinds of humans than our ancestors and predecessors? Is this good or bad?

There are ways in which technology makes us less dependent on others, more autonomous. Personal independence is a value, however. How much independence of others is enough? too much?

Technology has "dehumanized" work. For 10,000 years we have associated human life with drudgery and manual labor. That is fast becoming passe. Also, dehumanization of some jobs (e.g., handling dangerous waste materials) will make life safer.

4. How will problems of the "dehumanization" be countered?

Answers will vary. Focus attention on the fact that this is ultimately a social problem rather than a technical one. Solutions and remedies will depend on public choices and consensus about these dehumanizing developments.

Reprinted from U.S. News & World Report

A Search for Life's Meaning In High-Tech Era

Traditional values of God, country and family will be strengthened even in a new age of individualism.

As technology grows more complex, Americans will become more intense in their search for religious meaning and spiritual well-being in a time of rapid change.

Likely to spread is belief in God or a Supreme Being to bring order and moral clarity out of technological complexity. Churches, synagogues and philosophical institutions will play a larger role in community life. Greater importance will be placed on traditional values of family, friendship and country.

"In the years to come, we should expect the quest for the sacred to intensify—from deeper religious beliefs and increased churchgoing to a resurgence of patriotism," predicts polling expert Daniel Yankelovich.

Church affiliation, forecasters agree, will grow beyond the 60 percent of Americans who are now counted as members and the 40 percent who show up for worship. This will come about in part because of lengthening life spans and the increase in the adult population, which traditionally shows the strongest interest in organized religion.

Wider offerings. Churches and synagogues will assume much greater roles as centers where people can gather to share common interests and get counseling for a range of problems from marital stress to career burnout.

Traditional boundaries separating Catholics, Protestants and Jews will continue to crumble as a result of increased intermarriage and a loosening of religious codes. No matter what the denomination, church leaders will be less dogmatic in their dealings with people.

Most significant in the changing role of organized religion will be the realignment of denominations along liberal and conservative lines.

The progressive view of mainline Protestants, Reform Jews and liberal Catholics is outward looking and egalitarian, stressing the brotherhood of human beings around the world.

This stance will be buttressed by a world that continues to shrink through global communication, increased immigration into the U.S. from non-European countries and the rapid growth of Christianity in Africa, Asia and Latin America. By 2033, the number of Christians in the Third World will swell from less than half to well over 60 percent of the planet's Christian population.

RICHARD KREMEL FOR USN&WR

Conservative sects, such as Southern Baptists, the Church of God and Orthodox Jews, will benefit from another trend: The need of many for simplicity and certitude.

Jeffrey K. Hadden, a sociologist at the University of Virginia, says future fundamentalism will follow the guidelines of today's television preachers: "Private and emotionally intense, but not very strict. The message will be one of practical benefits—of feeling better quickly without much attention to the details of what you should believe."

The next century will also herald a new age of individualism as tomorrow's Americans look more to themselves as the frame of reference and show less allegiance to authority.

"In the future, people will have more autonomy and exert more control over their lives," says Marie Spengler, director of the values-and-lifestyles program at SRI International. This climate will open the door to more diversity of lifestyles and beliefs.

Still, for many individuals, the primary struggle will be with loneliness and the quest for human love in a world overwhelmed by too much information from computers, two-way television and the like—what Michael Marien, an editor for the World Future Society, calls the "Age of Infoglut."

William Kuhns, communications professor at the University of Ottawa, warns that unmanageable amounts of knowledge could force Americans into "tiny specialized tribes, interlocked electronically, perhaps faceless to one another, sharing a private language, a private interest, and all the time becoming more solitary and introverted."

The prospect of isolation and selfishness in such a decentralized society could give rise to small ideological communities where people of similar beliefs gather for support.

It could also spawn a new genre of spiritual free-lancing by preachers, therapists and counselors who promise instant happiness to their followers.

What concerns religious leaders is that moral values could be turned into "commodities to be acquired and disposed of according to the tastes and whims of shoppers," says Prof. Ted Peters of the Graduate Theological Union in Berkeley, Calif.

Families return to strength. In this shifting environment of high technology, futurists predict a greater role for the family unit. "By allowing people to work and learn at home, computers will restore families as society's masters and as antidotes to the coldness and clumsiness of bigger institutions," says David P. Snyder, lifestyles editor of *Futurist* magazine.

For all Americans in coming decades, one of the greatest concerns will be how to control the dangers of technology. As a result, ethics will become a matter of national policy. At Harvard University, ethicist Sissela Bok already notes sharply rising enrollment in traditional ethics courses after years of virtual eclipse.

"On issues such as nuclear weapons," she says, "technical complexities will need more and more to be balanced by fundamental human values preserved in churches and families." □

Copyright 1983, U.S. News & World Report, Inc.

Friday, March 26, 1982

Scientist believes technology leads to doom or utopia

By Carle Hodge
Republic Science Writer

Computers and robots will transform the world, a scientist said Thursday, in "truly staggering" ways not yet fully foreseen.

Advances in technology could put "peace and plenty for all" within human grasp for the first time, Dr. Walter Orr Roberts declared at Arizona State University.

He warned, however, that a "dreadful" alternative could be "long, dark ages" of despair and doom.

A utopian world must be pursued "with will," said the noted solar astronomer in the main address at the inauguration of ASU President J. Russell Nelson.

Roberts is director emeritus of the National Center for Atmospheric Research in Boulder, Colo., and a former president of the American Association for the Advancement of Science.

A "gigantic information revolution" is in progress, he told a Gammage Center audience, much of it a palette of the rainbow hues of academic tassels and hoods.

He estimated that half of all employed Americans now are engaged in producing or processing information — and those ranks will grow.

"As the need wanes for human labor to manufacture the material goods of society, our occupation patterns are evolving increasingly to the management of information," he said.

A computer chip the size of a postage stamp can contain 200,000 circuit elements, Roberts said, and perform tasks that would have required a room-sized computer in 1950.

Although computer circuits remain less complex than neurons of the human brain, they operate far faster, he explained.

"By 2000 A.D., the computer complexity will just about match the brain, and its speed should be perhaps 100,000 times greater," Roberts said.

"By that date, we expect computers to be about a million times more powerful than today's — or a million billion times more powerful than those of 1950.

"It is fascinating to conjecture about the uses to which such machines can be put, and the ways that we will have to devise to use them beneficially," he said.

Robots, which already are performing tasks too tedious or dangerous for humans, "are part of any realistic vision of the future," Roberts said.

He said he believes robots, like computers, will become "a humanizing force and a major factor in providing a better life for all."

He conceded, however, that "like all products of the creative mind," technology can be turned to "fearfully evil" purposes.

The world, he said, must "master the social, policial, economic and ethical forces that govern the use of our new powers."

This, Roberts argued, will be the prime intellectual task for the remainder of the 20th century, and it will not result from an armaments race.

Reprinted with permission from *The Arizona Republic*.

BEST COPY AVAILABLE

ACTIVITY 22

BRIGHT NEW WORLD OR GLOOM AND DOOM?

Much of the material in the *Visions of the Future* booklet focuses on the prospects of a bright new world. It has probably offered you a new perspective on issues that you previously believed would have a gloomy future. Has *Visions of the Future* changed your thinking? How? On what issues? Why?

Read the article that follows and be prepared to discuss your answers to these questions in class.

Answers will vary according to the individual. It is appropriate for students to insist that their thinking has not changed, but they should be challenged to see that they are better off for having thoroughly investigated the reasons and facts behind their thinking. Encourage them to remain open and inquisitive about those areas where their thinking has changed. Discourage intellectual complacency, and encourage "restlessness" and critical thinking about the future. It hasn't arrived yet so no one really "knows" it!

---

17 scientists envision bright new world

Updated report disputes gloomy view of life in year 2000

Economist Julian Simon: World is waiting for "good news."

"If present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now."
—GREG. 2000 Report to the President, 1980

By Ronald Kotulak
Science Writer

FOR MORE THAN a decade, the prophets of gloom and doom have had their way, painting a frightening picture of the world coming apart at the seams.

But they are "dead wrong," according to a new report that concludes that the pessimistic predictions of poverty, hunger and overcrowding are based on miscalculations that are "ignorant and arrogant."

People in the year 2000 will be richer, healthier, better fed and they'll live longer than people today, according to the new assessment. Even oil prices are likely to be lower.

The new report, called "Global 2000 Revised," is the work of 17 prominent United States scientists who are experts in economics, agriculture, geology and other fields.

Directed by Julian L. Simon, professor of economics at the University of Illinois in Urbana-Champaign, and Herman Kahn of the Hudson Institute, a New York think tank, the report was to be presented Sunday at the annual meeting in Detroit of the American Association for the Advancement of Science, the world's largest scientific organization.

THE SCIENTISTS were sharply critical of the two major doomsday reports, the Club of Rome's "The Limit to Growth" and the "Global 2000 Report," an official document that has influenced crucial government policies.

The Club of Rome report has been "damned as foolishness or fraud by every serious economic critic" and the "Global 2000 Report" is "fundamentally wrong and badly misleading," said Simon.

"The U.S. public must come to hear the truth that conditions have been getting better rather than worse, and that enthusiastic and vigorous efforts to do even better even faster will benefit the public as well as the individuals who act economically to bring about this social prog-

Continued on page 10, col. 1

World

Continued from page 1

ress," he said.

"The world is ready to turn its back on its pessimism, and is waiting to hear some good news."

Gerald Barney, an Arlington, Va., consultant who directed the "Global 2000 Report" for former President Jimmy Carter, said that though the report has some weaknesses it is "far and away the most thorough, most complete, most open, most thoroughly referenced study of world problems yet done by any nation."

"I generally stand by the report but there were some changes made by the government which I don't fully support," he said.

ALTHOUGH BARNEY did not detail his differences with government bureaucrats, the report portrayed a bleak and alarming future . . . "For hundreds of millions of the desperately poor, the outlook for food and other necessities of life will be no better. For many it will be worse.

"Barring revolutionary advances in technology, life for most people on earth will be more precarious in 2000 than it is now."

Simon and Kahn call these dire predictions "nonsense." They claim that the report was replete with major errors, its computer models inaccurate and its conclusions unfounded.

"The overall picture it paints of global trends is fundamentally wrong, partly because it relies on nonfacts and partly because it misinterprets the correct facts it does present," they said.

The revised report was originally commissioned by the Environmental Protection Agency to evaluate the Global 2000 study but when it became clear that the new study would be sharply critical of the Global report, there was political pressure to have EPA withdraw its support, said Simon. The revised report was finally completed with funding from the Heritage Foundation, a conservative think tank based in Washington, D.C.

THE SIMON and Kahn team went over the same ground as the Global report but came up with opposite conclusions:

- If present trends continue, the world in 2000 will be less crowded, less polluted, more stable ecologically and less vulnerable to resource-supply disruption than the world we live in now.
- The world's people will be richer in most ways than they are today.
- The outlook for food and other necessities of life will be better . . . life for most people on earth will be less precarious economically than it is now.

"We do not say that all is well everywhere, and we do not predict that all will be rosy in the future," Simon and Kahn said in the report.

"Children are hungry and sick people live out lives of physical or intellectual poverty, and lack of opportunity, war or some new pollution may flourish us.

"What we are saying is that for most relevant matters we have examined, aggregate global and U.S. trends are improving rather than deteriorating."

AMONG THE highlights of their report, many of which are sure to be criticized by other scientists, are:

- Life expectancy has been rising rapidly throughout the world, a sign of demographic, scientific and economic success.
- The birth rate in less-developed countries has been falling, probably a result of modernization and of decreasing child mortality, and a sign of increased control by people over their family lives.
- Though there are still many hungry people, the food supply has been improving, as measured by grain prices, production per consumer and the famine death rate.
- Trends in world forests are not worrisome, taken as a whole, though there are places where deforestation is troubling.
- There is no evidence for the rapid loss of species in the next two decades that has been widely warned about.
- The widely publicized report of increasingly rapid urbanization of U.S. farmland was based on faulty data.
- Water does not pose a problem of physical scarcity or disappearance, although the situation does call for better institutional management through a more rational system of property rights.
- The climate does not show signs of unusual and threatening changes.
- Mineral resources are becoming less scarce rather than more scarce.
- There is no persuasive reason to believe that the world oil price will rise in coming decades. The price may fall well below what it has been.
- Nuclear power gives every evidence of costing many fewer lives per unit of energy produced than coal or oil. It is also very much cheaper than oil.

ONE OF THE major weaknesses of the "Global 2000 Report" is that it neglects longterm trends, such as man's ability to deal with global problems, said Simon. The growing concern over the buildup of carbon dioxide in the atmosphere and the acid rain fallout from coal-fired power plants, for instance, could be eased by converting to nuclear energy, he said.

Our report is extremely optimistic about what the physical limits of the world will allow us to do," he said. "But it is not so optimistic about what our politics and popular psychology will allow us to do."

Copyrighted 1983, Chicago Tribune. Used with permission.

BEST COPY AVAILABLE

PROBLEM SOLVING IN A TIME OF CHANGE

100. In post-industrial societies, things change . . . *(b)*
(a) slowly (b) rapidly (c) accidentally (d) dangerously

101. In rich countries, a major reason that economic growth slows is . . . *(b)*
(a) there is no longer access to raw materials
(b) people change their attitudes toward growth
(c) the GNP reaches a maximum
(d) land is used up

102. Which of the following are "understandable and solvable" problems . . . *(d)*
(a) population growth
(b) running out of raw materials
(c) world food supplies and distribution
(d) a, b and c

103. An example of a possible "unsolvable" problems is . . . *(d)*
(a) terrorism
(b) bad management
(c) environmental disaster
(d) a, b and c

104. In the future, the term, "engineer" may refer to people who work with . . . *(d)*
(a) genetics (b) robots (c) lasers (d) a, b and c

105. Technicians who develop artificial limbs are called _____ technicians. *(a)*
(a) bionic (b) laser (c) photonic (d) robot

106. "Geriatric" social workers specialize in helping . . . *(d)*
(a) children (b) technicians (c) families (d) the elderly

107. Changes in attitudes toward growth can create . . . *(d)*
(a) a J-curve
(b) a spike curve
(c) exponentiality
(d) a countervailing force

108. My choice of _____ can help solve world problems.
(a career)